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MONTEREY, CALIFORNIA

THESIS

**THE CHALLENGE OF CYBER POWER FOR CENTRAL
AFRICAN COUNTRIES: RISKS AND OPPORTUNITIES**

by

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December 2012

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**THE CHALLENGE OF CYBER POWER FOR CENTRAL AFRICAN
COUNTRIES: RISKS AND OPPORTUNITIES**

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ABSTRACT

In a context where cybersecurity is becoming a major concern of so many of the world's countries, some in Central Africa seem not to be concerned. In the meantime, due to the strength of a growing economy, there is a growing penetration of information technologies in this region. Governments are striving to catch up to this reality. The Central African militaries, which are supposed to be the first line of defense for their governments' institutions, are dramatically behind the times. To address this situation, the governments of Central Africa need to adopt a collaborative cyber strategy based on common investment in secure cyber infrastructures. Such cooperation will help to create a strong cyber environment conducive of the confidence and trust necessary for the emergence of a cyber community of Central African States (C3AS). For Central African militaries, massive training and recruiting will be the first move to begin the process of catching up.

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LIST OF ACRONYMS AND ABBREVIATIONS

3G	Third-Generation Mobile Phone Technology
4G	Fourth-Generation Mobile Phone Technology
ACE	Africa Coast to Europe Submarine Cable
ADSL	Asymmetric Digital Subscriber Line
ATM	Automatic Teller Machine
C3AS	Cyber Community of Central African States
CAB	Central African Backbone
CAR	Central Republic of Africa
CDMA	Code Division Multiple Access
COTS	Commercial Off The Shelf
CYBINT	Cyber Intelligence
DIME	Diplomacy, Information, Military, and Economic
DRC	Democratic Republic of The Congo
ECCAS	Economic Community of Central African States
E-FAX	Electronic Fax
E-MAIL	Electronic Mail
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HF	High Frequency
HUMINT	Human Intelligence
I.D.	Identification
ICT	Information and Communication Technology
IP	Internet Protocol
ISP	Internet Service Provider
IT	Information Technology
IXP	Internet eXchange Point
NICI	National Information and Communication Infrastructures
OF	Optical Fiber
OS	Operating System
PKI	Public Key Infrastructure
QoS	Quality Of Service
RASCOM	Regional African Satellite Communications

SME	Small and Medium Enterprises
SMS	Short Message Service
STP	Sao Tome and Principe
VHF	Very High Frequency
VOIP	Voice Over Internet Protocol
VSAT	Very Small Aperture Terminal
WASC	West Africa Submarine Cable
WIFI	Wireless Fidelity
WIMAX	Worldwide Interoperability for Microwave Access

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I. INTRODUCTION

A. PROBLEM IDENTIFICATION

A growing number of cybersecurity incidents has taken place in African countries. These include anonymous calls and/or e-mails for blackmailing, web defacement of government sites, long service interruptions of websites, due to system failure or insufficient equipment, frequent scamming plots originating from the subregion, and smuggling of animal and natural resources facilitated by the Internet.^{1,2,3,4} Unfortunately, these incidents have shown that African governments are inadequately prepared to exercise authority in the cyber domain. This situation has forced some governments to legislate on the matter, but the laws are far from complete or enforceable. Many steps are still needed for these laws to become enforceable, like penal procedures, specialized law-enforcement personnel, specialized infrastructures, and software. Lacking a sound cyberspace security strategy, Central African countries will likely allow vulnerabilities to continue to grow to the point that their cyberspaces will become safe havens for criminals and terrorists. Key issues in the cyber domain in Central Africa can be framed along two major axes: the inability of governments to seize the potential that the cyber domain offers to improve their efficiency, or cyber power;⁵ and the risk posed by the lack of a cybersecurity strategy to guarantee the safe growth of cyberspace.

¹ “How to Avoid Cameroonian Scams: Frauds Originating From Cameroon,” *US Embassy Website*, Accessed March 6, 2012, http://yaounde.usembassy.gov/scams_warning.html.

² Issa Sikiti, “Africa: Cybercrime Increase Worries, Vulnerable Groups Targeted,” *All Africa*, September 29, 2011, accessed June 10, 2012, <http://allafrica.com/stories/201109290659.html>.

³ Ntaryike Divine, Jr., “Cameroon Urged to Act Against Cybercrime: Government proposes stricter monitoring of Internet,” *Voice Of America News*, February 10, 2011, accessed March 06, 2012, <http://www.voanews.com/english/news/africa/central/Cameroon-Internet-Scamming-10Feb11-115732229.html>.

⁴ “Cameroon Wildlife Internet fraudster arrested,” *WildLifeDirect*, June 14, 2008, accessed March 6, 2012, <http://baraza.wildlifedirect.org/2008/06/14/cameroon-wildlife-internet-fraudster-arrested/>.

⁵ Sheldon B. John, “Deciphering Cyberpower: Strategic Purpose in Peace and War,” *Strategic Studies Quarterly*, Summer 2011, accessed April 02, 2012, <http://www.au.af.mil/au/ssq/2011/summer/sheldon.pdf>.

B. PURPOSES AND OBJECTIVES OF THE RESEARCH

1. Significance of the Project and Rationale

In the same manner in which it is growing around the world, cyberspace is growing in Central Africa—along with threats. Governments cannot disregard enforcing their authority in both physical and cyber space. There are some measures being taken to improve the presence of government in cyberspace. However, there is too much to be done with not enough means, from knowledge acquisition (basic, intermediate, and expert education), to building infrastructure and creation and enforcement of regulations. Most of these efforts are designed to make cyberspace operational. On the other hand, other initiatives concerned with securing the whole system and giving governments more control have been ignored and put off, to be worked out in the future. Central African militaries, whose basic roles are to guarantee their countries' sovereignty, seem unprepared to fulfill their missions in the cyber realm. Opening this debate within the Central African military community is a good first step towards filling this gap.

Increasing cybersecurity can lead to numerous positive spillover effects. Public trust in the Central African cyber domain will bring local economic entities to invest in the electronic-business sector. Similarly, more confidence will attract more international financial transactions and increase Central Africa's competitiveness. Limiting the amount of criminal acts in the regional cyber domain will diminish the negative perception of the region in the world, thus increasing its attractiveness, or soft power.⁶ An efficient cyber strategy that integrates a regional vision would help overcome the financial barrier to infrastructure investment. In the militaries of Central Africa, where the acknowledgement of cyberspace and cybersecurity is still in its infancy, debate on the matter will be quite beneficial, as it will help military planners define adequate future directives in order to counter and preempt cyber threats in a more globally integrated fashion.

⁶ Joseph S. Nye Jr, *Soft Power: The Means To Success In World Politics*, New York: Public Affairs, 2004.

2. Statement of Purpose and Scope

The purpose of this thesis is to examine how Central African governments can increase their cybersecurity in order to prevent cyberterrorism and crime. In addition, the study intends to analyze what kind of cyber strategy will best aid Central African governments' overall security. In this light, a Central African vision for cyberspace should encompass the lessons learned in the successes and failures already witnessed elsewhere across the world.

In the area of security and cyberspace, militaries have played a significant role in the development of new technologies. The technologies used to defend and attack networks and information-technologies systems are often created in military facilities, as threat assessments have led strategists to believe that future battles will involve cyberspace.^{7,8,9} One of the prime missions of a military force is to be ready for any type of threat to the sovereignty of the state, and so must be the militaries of Central Africa.¹⁰

In every society, government as the guarantor of civil liberties is bound to be ready to exercise authority in cyberspace, as in other realms. Many concerns exist about the authority of governments in the cyber domain. A gain in security, if not enforced adequately, may lead to the loss of individual liberties. To what level of individual liberty should members of a society compromise to benefit security?

A security strategy in cyberspace will require two urgent and bold approaches. First, it should incorporate a regional approach with sharing of critical and often very sensitive information-technology resources to overcome the limited cyber capabilities of Central African countries. Second, it should include the development of harmonized regional and international norms. Geographically, this thesis will focus on the Economic

⁷ John Arquilla, "Cyberwar Is Already Upon Us: But Can It be Controlled?" *Foreign Policy*, April 2012, accessed February 27, 2012,

http://www.foreignpolicy.com/articles/2012/02/27/cyberwar_is_already_upon_us, 1.

⁸ Richard A. Clarke, and Robert K., Knake, "Cyber War: The Next Threat to National Security and What To Do About It," (New York: HarperCollins Publishers, 2010), 64-68.

⁹ John Arquilla, "From Blitzkrieg to Bitskrieg: The Military Encounter with Computers," (Communication of the ACM 54, n°10 2011), 58-64.

¹⁰ Alice R. Buchalter, "Military Support to Civil Authorities: The Role of the Department of Defense in Support of Homeland Defense," *Federal Research Division Library of Congress*, February 2007, accessed March 06, 2012, http://www.loc.gov/rr/frd/pdf-files/CNGR_Milit-Support-Civil-Authorities.pdf.

Community of Central African States (ECCAS), which comprises Cameroon, the Central Republic of Africa, Chad, the Democratic Republic of the Congo, Equatorial Guinea, Gabon, the Republic of the Congo, and Sao Tome and Principe.¹¹

C. RESEARCH QUESTION

What are the measures that Central African countries can take to increase their cybersecurity?

To answer this question, it is important to understand how cyberspace stands in Central Africa and to study the risks pertaining to cyberspace. A thorough examination of the roles of states in cyberspace will help illuminate the axes of leverage available for increasing cybersecurity. This analysis will also reflect on each state's social, economic, and political atmospheres. Emphasis will be placed on the role of the military in achieving this goal.

D. METHODOLOGY

1. Methodology

In this thesis research, the intention is to make an empirical study that examines the key factors that pertain to cybersecurity in Central Africa. The overall framework of this thesis will be twofold. First, it will examine and identify existing cyber assets and mechanisms that can lead to cyber risk. Second, it will determine the role of government in cyberspace and what axes of leverage are possible to mitigate existing threats. As a subset of the second frame, this research will analyze how the military can contribute to increasing cybersecurity in Central Africa.

¹¹ "Communauté Economique des Etats de l'Afrique Centrale," *CEEAC-ECCAS*, accessed August 23, 2012, <http://www.ceeac-eccas.org/>.

2. Elements of the Framework

a. Understanding Cyber Security Risks: The Case of the ECCAS

Cybersecurity in the Central African region will be assessed based on the examination of five areas of risk in cyberspace: laws and regulations, infrastructures, information systems, business and industry, and society (see Figure 1). This chart summarizes the five identified areas of risk (green boxes) and their dependent variables (yellow boxes), where cyber threats (blue boxes) can take advantage to create problems for governments. To be thorough in the evaluation of cybersecurity risk, we will assume that the likelihood of a cyber incident can be extrapolated from other places in the world where a similar set of conditions has led to security concerns.

b. Roles of Governments in Cyberspace, Axes of Leverage: Case of ECCAS

A government's mission should be to give the people prosperity and stability (civil liberties, security, wealth, etc.) within their territory. By definition, states play an important role in cyberspace, as it is part of a country's assets, and events in cyberspace can have direct impacts on the physical world. The assessment of the role of government in cyberspace will be done through the four instruments of national power: diplomatic, informational, military, and economic (DIME). Figure 2 summarizes the objectives and actions (blue boxes) of governments in cyberspace in relation to the government's power instruments (red boxes) and the areas in cyberspace (green boxes) where actions are needed, postulating how the action can be exercised (yellow boxes). This research looks at how these instruments of power can be used to reduce risk in cyberspace.

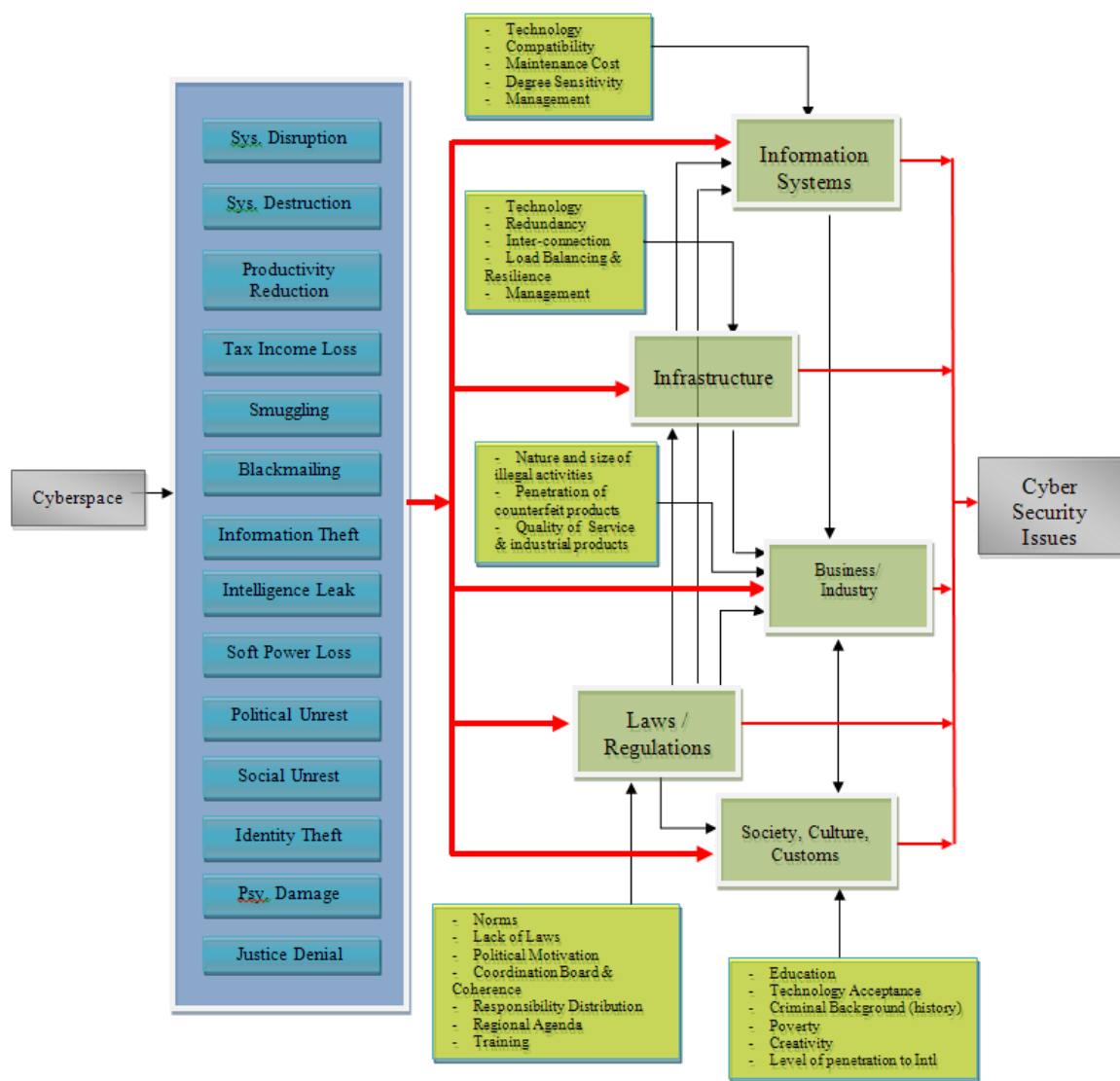


Figure 1. Areas of Risk from Cyber Threats

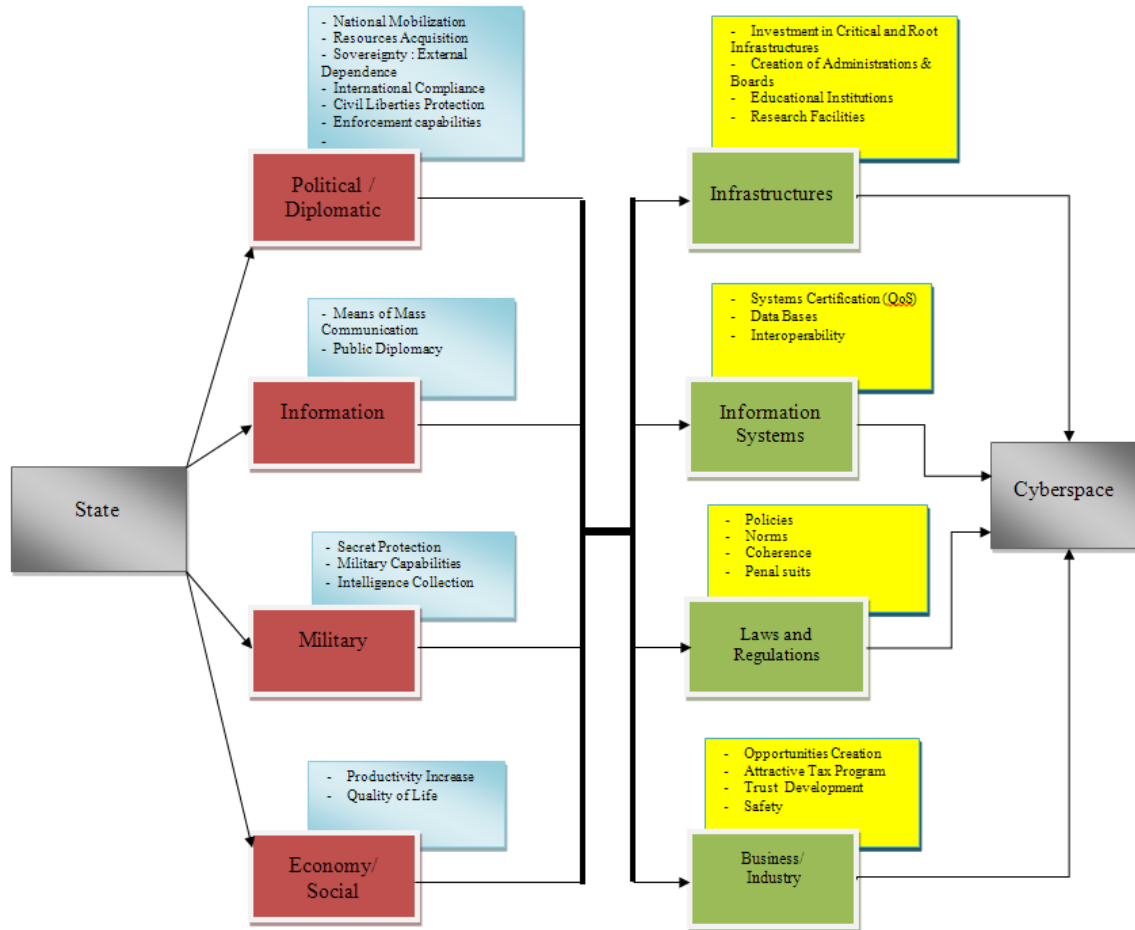


Figure 2. Meeting Government Objectives in Cyberspace

c. Solution for Empowering Cyberspace in Central Africa

The salient question is to establish whether a regional approach to mitigating cyberspace risks (to improve productivity and quality of service) can offer the ECCAS community better chances of success than an approach based on individual, uncoordinated effort. Given the socioeconomic context, which is similar throughout the subregion, the preexisting collaborative background (sociologic, economic, and diplomatic), and the experience learned from across the world, the ECCAS community has everything to gain from combining their individual assets to improve cyber readiness.

In a context where actionable resources are rare and scattered across the ECCAS, one can hypothesize that a collaboration build upon the economic community already in place that promotes the sharing of cyber resources and capabilities within the region is a good starting point. Such cooperation will help create a strong cyber environment conducive of the confidence and trust necessary to initiate a “cyber community of Central African states” (C3AS).

E. BLUEPRINT

This thesis is organized into an introduction, five chapters, and seven appendixes. The first chapter, Chapter I – Introduction – presents the context and interest of this research, and finally defines the methodological framework of the thesis.

Chapter II defines the cyberspace of Central Africa. It summarizes the cyber assets of Central Africa by examining five principal aspects: infrastructures; information systems; business and industry; laws, regulations, and administration; and society and culture. Each of these aspects organizes into multiple subsets of indicators.

Chapter III raises concerns about the potential threats to which Central African states are exposed in their development of cyber capabilities. This chapter emphasizes cyber intelligence and its prospects for the intelligence community. A final debate is made on the place of human intelligence in an environment where information technologies are thriving and growing.

Chapter IV examines the role of Central African states in cyberspace, first by reviewing state objectives in that realm, then by examining how states can achieve their objectives. This latter concern will be explored using the constituent elements of state power, which are the political and diplomatic, the informational, the economic and social, and the military. This chapter suggests some ways to measure the effects of state elements of power on cyberspace.

Chapter V considers how the military in Central Africa might handle technological changes. This chapter identifies the fronts of technological penetration and the sources of technological innovation within the military. It also examines the

relationship between Central African military doctrine and technology. In a context where the security aspects of cyberspace are yet to be developed, the overall goal is to find some venues to raise more interest within the military about cyberspace and cyber readiness.

Chapter VI presents a general conclusion and proposes solutions to the security challenges of Central African cyberspace. The creation of a cyber community of Central African states, where mutualization of resources, cooperation, and increased engagement of a regional security apparatus are in place, can help to sustain stable development.

The thesis closes with seven appendixes that give a thorough description of the states that constitute the Economic Community of Central African States. Each of these appendixes is organized into five subheadings that deal with infrastructure; information systems, business and industry; laws, regulations, and structural organizations; the use of information technologies in the society and culture; and criminal activities registered in the cyberspace in Central Africa.

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II. DEFINING CENTRAL AFRICAN CYBERSPACE

A. INTRODUCTION

This chapter gives a description and history of Central African cyberspace and cyber crimes or incidents. The subregion of Central Africa will be limited to the countries that are members of the Economic Community of Central African States (ECCAS), which comprise eight countries: Cameroon, the Central African Republic, Chad, the Democratic Republic of the Congo, the Republic of the Congo, Equatorial Guinea, Gabon, and Sao Tome and Principe (see Figure 3).

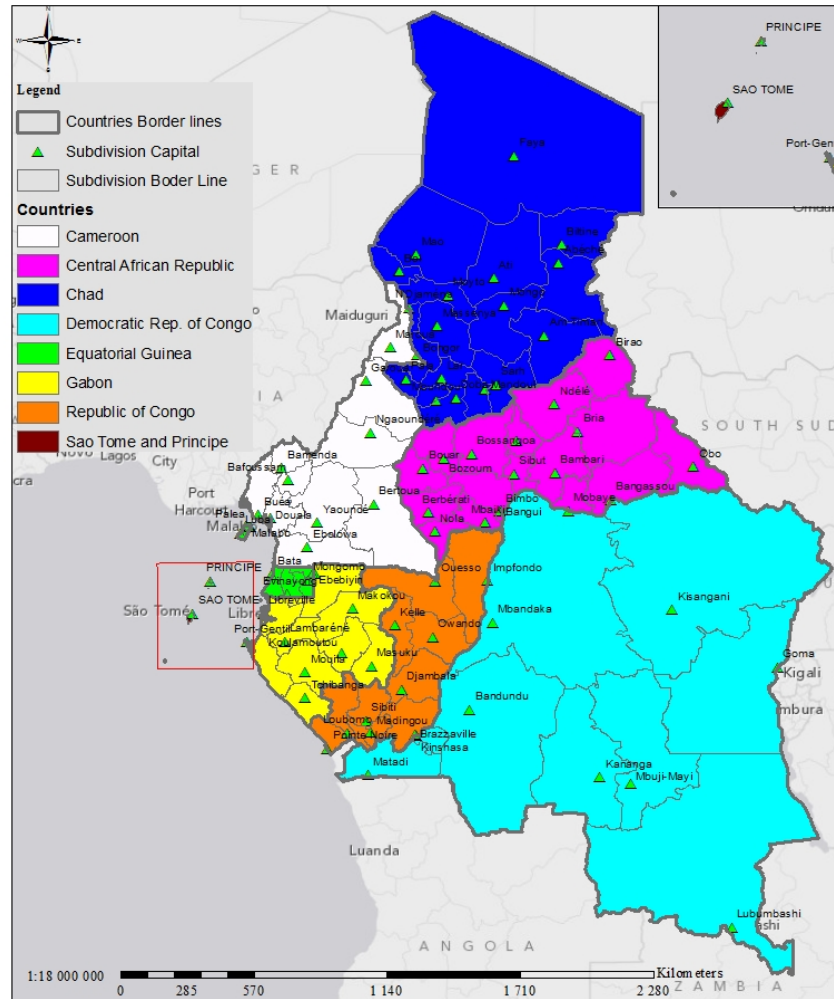
This chapter examines the cyberspace of the ECCAS by looking at infrastructure; information systems; business and industry; laws, regulations, and administration; and society and culture.

The definition of cyberspace in this thesis encompasses all assets that contribute to information and communication technologies (ICT), including telecommunications infrastructure, energy, information technology (IT) services, laws and regulations, business and industries, and the society of ICT consumers.^{12, 13}

Though we would like to have statistical data at the subdivision (city) level for each country for a more accurate picture of its cyberspace, the reality of data collection and unavailability force us to remain at the country level.

¹² T. Unwin , “ICT4D, Information and communication technology for development,” Cambridge: Cambridge University Press, 2009.

¹³ Kuehl, “From Cyberspace to Cyberpower: Defining the Problem,” 22.



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Figure 3. Economic Community of Central African States' Administrative Subdivisions and Capitals

Overall, the following paragraphs provide a general overview of current activities and issues related to the cyberspace of the ECCAS subregion. The data presented here should be regarded as illustrative rather than exhaustive. ICT use in these countries is at a particularly dynamic stage, with new developments and announcements happening on a daily basis everywhere. Therefore, this analysis should be seen as “snapshots” that were current at the time they were taken; it is expected that certain facts and figures presented will become outdated very quickly.

In the ECCAS region, the existing reality of cyberspace is quite complex, although very limited. The overall index of cyber readiness for the region is evaluated as a two on a scale of one to seven, which places the region in the very bottom of the world list.¹⁴

B. INFRASTRUCTURES

From the infrastructure perspective, cyberspace in the Central Africa community is at the brink of a tipping point. The year 2012 was the promised year of accomplishment for many projects in all eight countries of the ECCAS subregion. These projects aimed to connect these partners to international undersea optical-fiber cables, followed by the interconnection of regional capitals in a Central African backbone, and finally by the interconnection of major cities through high-capacity communications links.¹⁵ The present telecommunication infrastructure landscape is dominated by wireless technology, either for distribution to the local population or for the interconnection of distant cities.¹⁶ Mobile telephony and mobile services are highly developed, especially in urban areas, although the rural sector does have an acceptable level of mobile penetration as compared to landline services. Surprisingly, and thanks to the portability of ICT, the ECCAS subregion is now benefiting from all the existing telecommunication solutions offered around the world. The miracle of competition has led to the introduction by

¹⁴ Soumitra Dutta and Beñat Bilbao-Osorio, "The Global Information Technology Report 2012: Living in a Hyperconnected World," *World Economic Forum*, accessed June 10, 2012, http://www3.weforum.org/docs/Global_IT_Report_2012.pdf, 197.

¹⁵ Republic of Cameroon, "Télécommunications et TIC: Bilan du septennat des grandes ambitions," *Ministry of Posts and Telecommunications*, February 2012, accessed August 2012, http://www.minpostel.gov.cm/index.php?option=com_content&view=article&id=125%3Ale-bilan-des-telecommunications-et-tic-dans-un-ouvrage&catid=50%3Aa-la-une&lang=fr, 95.

¹⁶ Mark D. J. Williams, Rebecca Mayer, and Michael Mingos, "Africa's ICT Infrastructure Building on the Mobile Revolution," *The World Bank* edited by Vivien Foster and Cecilia Briceño-Garmendia, 2011, accessed August 23, 2012, http://siteresources.worldbank.org/INFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/AfricasICTInfrastructure_Building_on_MobileRevolution_2011.pdf.

mobile-phone companies of 4G, 3G, GPRS, and CDMA networks for the population.¹⁷ Internet access, when available, remains insignificant from a global world perspective and is still expensive, due to the reliance on satellite for bandwidth access in many ECCAS countries. The absence of local Internet-managing infrastructures like Internet eXchange Points (IXPs) contributes to a high cost for Internet access. Projects backed by the World Bank are underway to fill the gap, namely, the Central African backbone, the WASC optical-fiber link, the African telecommunications satellite RASCOM,¹⁸ and many others.¹⁹

One of the issues that has a direct impact on ICT infrastructure development and exploitation is energy. Although the ECCAS region is endowed with huge potential hydroelectric energy in the Democratic Republic of the Congo, Cameroon, and Gabon, these countries have not yet come out with a genuine exploitation plan to overcome the energy gap in the region.²⁰ ECCAS countries remain burdened by an energy gap with a direct impact on daily life: limited access to electricity in households, multiple power shortages, and bad distribution of electricity in urban and rural areas.²¹ These difficulties endanger existing ICT infrastructure and pose serious threat to cyberspace development. Figure 4 shows the status of broadband network infrastructures, access to undersea cables, power plants, roads and electricity networks in the subregion of Central Africa.

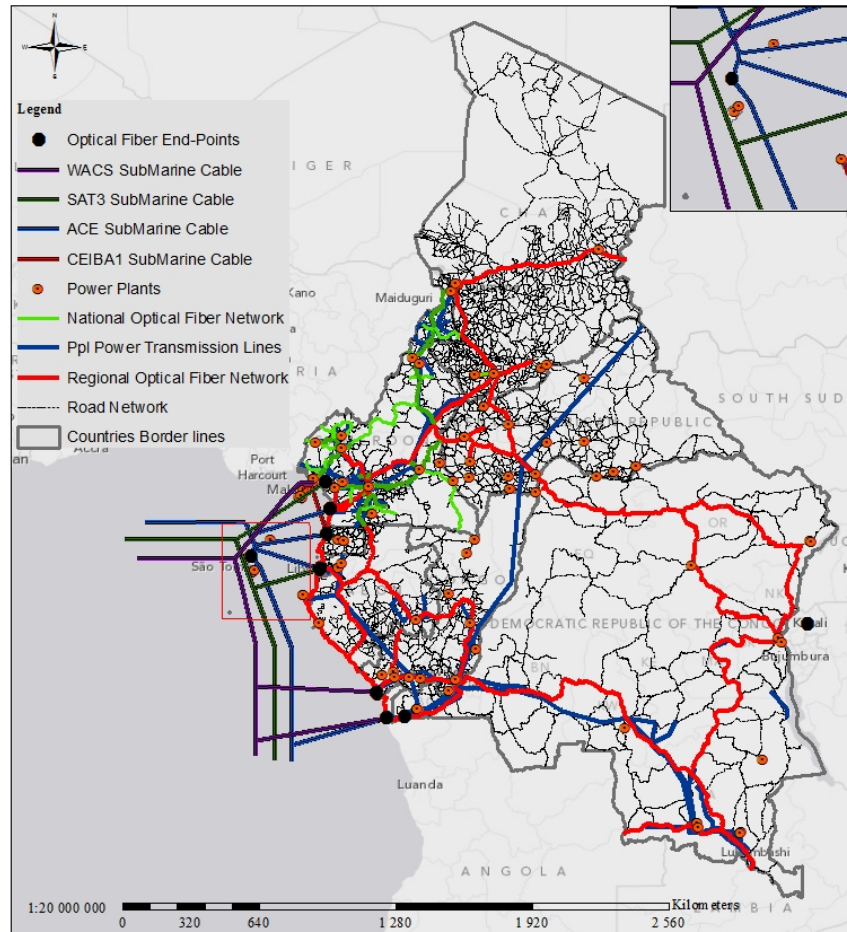
¹⁷ Acobo Garcia-Palencia, Juan Jose Rio, and Dimitris Lioulis, "ICT in Emerging Markets: A USD 200 BLN OPPORTUNITY THAT CANNOT BE IGNORED," *Delta Partners – White Paper*, May 2011, accessed June 10, 2012, <http://www.deltapartnersgroup.com/ict-in-emerging-markets-a-usd-200-bln-opportunity-that-cannot-be-ignored>.

¹⁸ "Members of the RASCOM Project," *RASCOM*, March 2005, accessed June 28, 2012, http://www.rascom.org/info_detail.php?langue_id=1&id_r=7&id_sr=0&id_gr=2.

¹⁹ "Equatorial Guinea Minister discusses telecommunications advances," *Equatorial Guinea News*, July 29, 2010, accessed July 12, 2012, http://www.youtube.com/watch?v=zTutYbgoWR0&lr=1&uid=w-fAmKLbw6kNshkn2_iTcg.

²⁰ Vivien Foster and Daniel Alberto Benitez, "The Democratic Republic of Congo's Infrastructure: A Continental Perspective," *AICD Country Report*, March 2010, accessed June 29, 2012, <http://www.ppiaf.org/sites/ppiaf.org/files/publication/AICD-DRC-country-report.pdf>, 6-8.

²¹ Anton Eberhard, et al., "Africa's Power Infrastructure Investment, Integration, Efficiency," *The World Bank* edited by Vivien Foster and Cecilia Briceño-Garmendia, 2011, accessed August 23, 2012, <http://www.ppiaf.org/sites/ppiaf.org/files/publication/Africas-Power-Infrastructure-2011.pdf>.



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Figure 4. ECCAS Cyberspace Infrastructures (Optical-Fiber Network, Power Plants, Submarine Cable Access)

C. INFORMATION SYSTEMS AND SERVICES

With respect to services offered in ECCAS cyberspace, much still has to be done. Most of what exists revolves around mobile communications, Internet access for web navigation (with little local web hosting), and voice over IP becoming a potential area of development. Electronic banking, especially money transfer, is also a forthcoming activity. Technical services offered in the ICT realm, such as Internet eXchange Points, public key infrastructure (PKI), server farms, cloud computing, or virtual environments,

are awaited. Although some mobile companies propose extending services they already have implemented abroad, local services are nonexistent. Within state administrations, some efforts are being made to develop online services or build utility information systems, but they are sparse and badly coordinated. These efforts, which are usually encompassed in an electronic-government type initiative, consist of interconnection of public administration within the government, computerization of some critical public services, such as human resources, salary systems, national identification systems, and customs exchanges.^{22,23} In other places, the mere fact of introducing computers into daily tasks is viewed as enough and accounts for computerization of the public service. The military, for their part, are very close to their civilian counterparts in term of cyber readiness, although some expertise exists due to the types of weapon systems that they possess or the mechanisms within the military that drive them to be ready for new forms of threat. The introduction and evolution of information systems in ECCAS public administration is more the result of individuals with high leadership and personal attraction to technology taking action than a systematic plan driving, and accounting for, every step. Figure 5 below give an overview of the level of activity registered in cyberspace of Central Africa; this estimation is extrapolated from the number of Internet host servers and the size of the data traffic measures across the subregion.

²² “E-Government Survey 2012,” *United Nation*, New York (2012), accessed June 29, 2012, <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan048065.pdf>.

²³ “République du Congo : Country Report,” *AZUR Développement*, 2008, accessed July 26, 2012, <http://www.giswatch.org/node/46>.

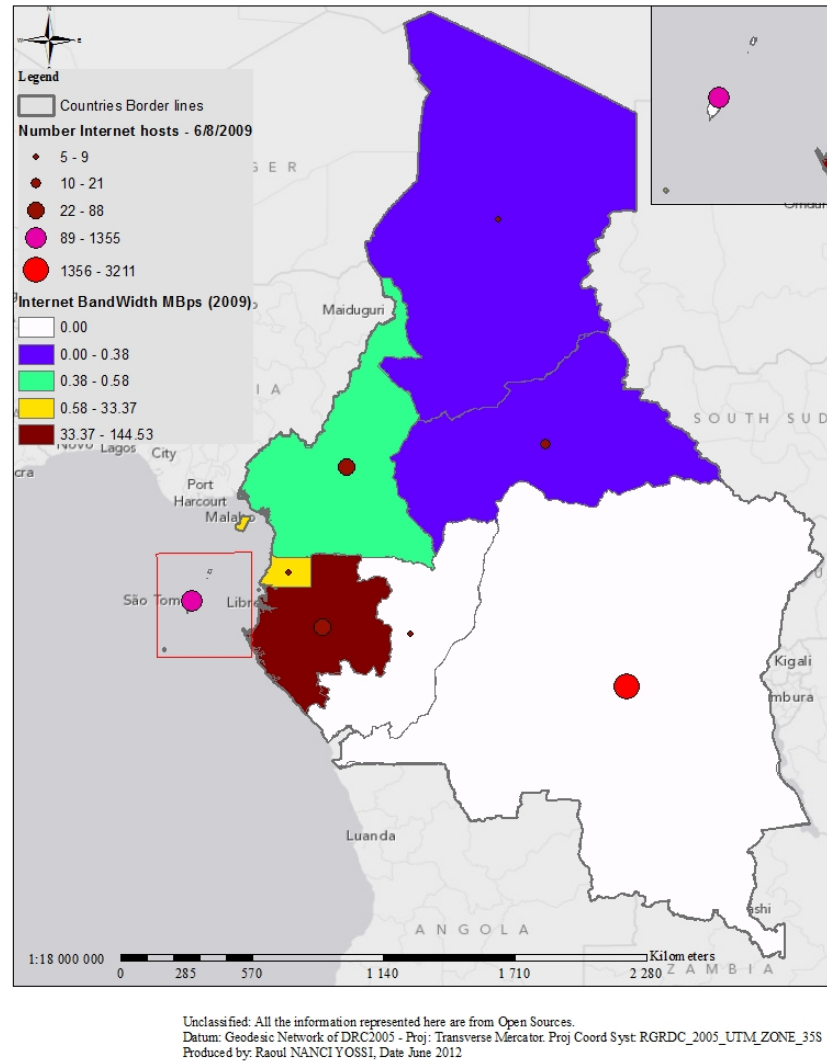


Figure 5. ECCAS Information System Utilization

D. LAWS, REGULATIONS, AND ADMINISTRATION

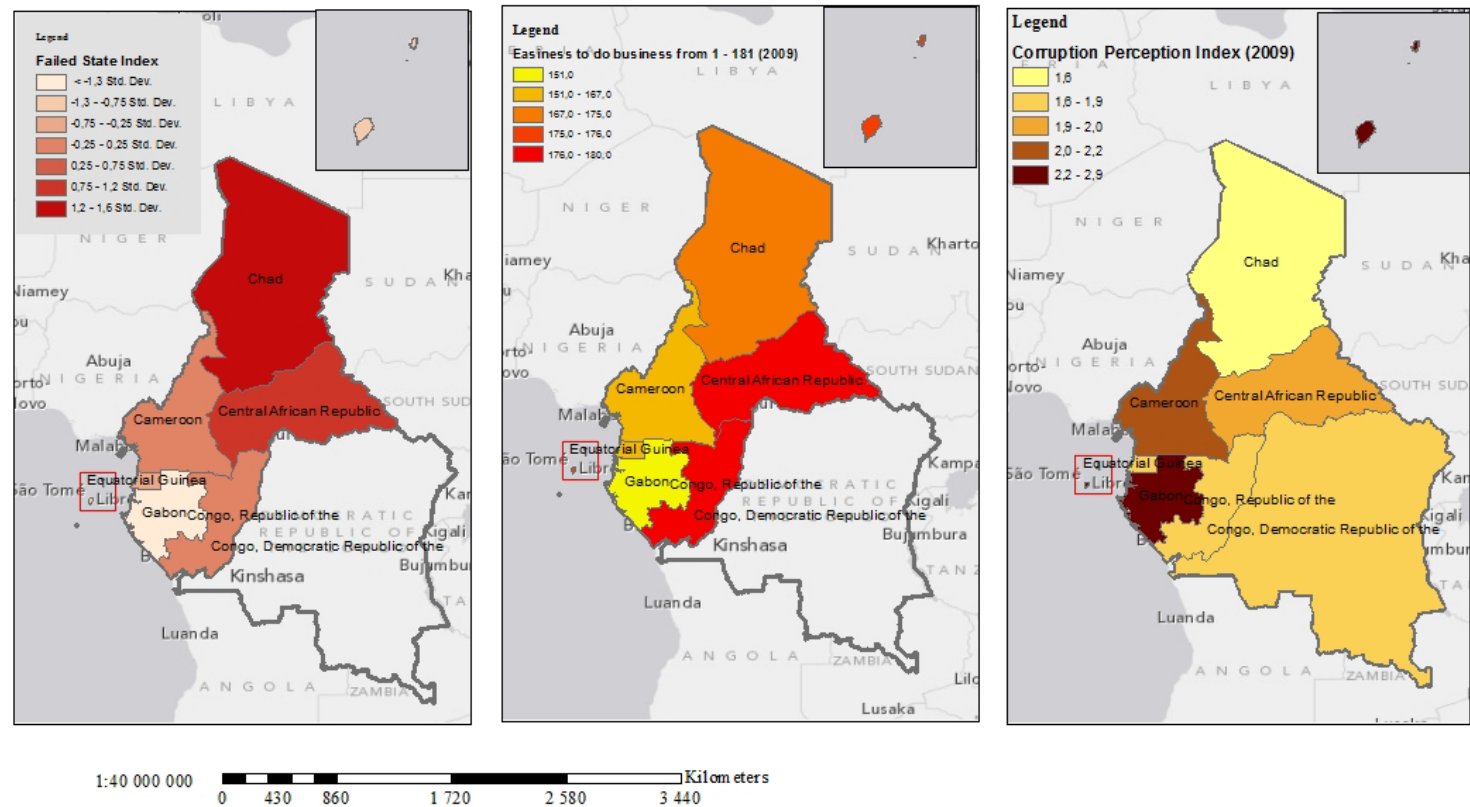
Within the subregion, the legal framework is completely torn apart. There are countries in the ECCAS that are advanced in the process of regulation building and awareness of cyberspace legal challenges and those that are barely concerned by cyberspace issues. Generally, in all the states, one can find an administration that is in charge of ICT, but the recurring problem is that the laws, regulations, and organizational charts are either incomplete or totally obsolete for dealing with the speeding realm of

cyberspace.²⁴ Central African countries are still limited by old telecommunications systems that were design for communication through microwave signals and wired analog telephony. All the issues related to electronic transactions or electronic venues are yet to be addressed; this opens the way for judicial discrepancies and criminal activities.²⁵ Another aspect that is common to the ECCAS subregion is the lack of cyberspace law-enforcement expertise.²⁶ The latest countries to have adopted cyber commerce and criminal laws have yet to acquire the expertise and infrastructure necessary to be fully operational. From a general perspective, according to data from a UN survey, and a failed state index of states in the subregion, heavy bureaucracies, and high levels of administrative corruption hinder the ability of governments to favor cyberspace development in the subregion of Central Africa (see Figure 6).

²⁴ Ewelukwa, "Is Africa Ready for Electronic Commerce...", 8.

²⁵ Rebecca Wanjiku, "Rising Cybercrime Pushes African Governments to Take Action," *CSO Online*, December 19, 2011, accessed June 11, 2012, <http://www.csoonline.com/article/696806/rising-cybercrime-pushes-african-governments-to-take-action>.

²⁶ Eric Agwe-Mbarika Akuta, Isaac Monari Ong'oa, and Chanika Renee Jones, "Combating Cyber Crime in Sub-Sahara Africa; A Discourse on Law, Policy and Practice," *Journal of Peace, Gender and Development Studies* Vol. 1(4), 129-137, May 2011, accessed June 11, 2012, <http://www.interestjournals.org/JPGDS/pdf/2011/May/Akuta%20et%20al.pdf>, 131-136.



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Figure 6. Laws and Regulations in ECCAS

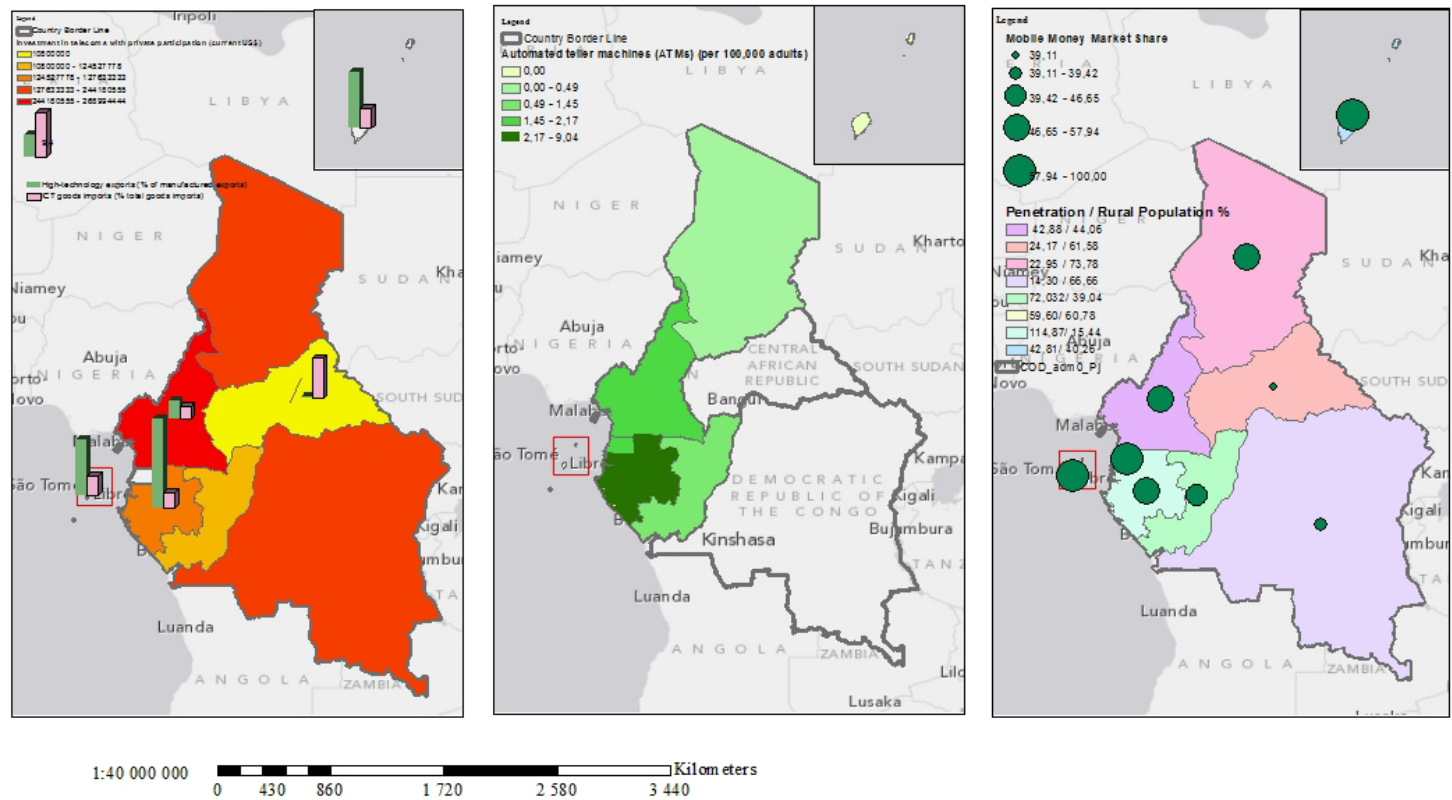
E. BUSINESS AND INDUSTRY

With respect to business and industry, the previous factors of infrastructure, network backbone, limited access to high-speed broadband, energy quality and supply, and regulation environment make it hard for ICT business and industries to prosper in the region. Nevertheless, a lot of small and medium enterprises (SME) exist, most of them branches of foreign companies or locals with contracts with foreign brands. The predominant sectors are web development, software engineering, telecommunication-infrastructure construction, system integration, and retail. A few assembly lines have been spotted in two or three states, but their production is very limited and essentially aimed at local consumption. Internet service providers (ISPs) are developing very fast and are widespread. In the tertiary sector, cybercafés with mobile calling services are a common business. Most of the hardware equipment is imported and retail of ICT products can also be considered a dominant venue.

As pointed out previously, electronic commerce is very low; the practice of selling goods online to citizens is thriving to take-off. Several reasons may be the cause, but one of the first is lack of trust. Indeed it is hard or even impossible to pinpoint cyber users in city address books. This, combined with the lack of an accountability mechanism, makes users not trust online sellers enough to send them their money without guarantee of receiving the merchandise. Although the seller might be trustworthy, delivery systems are either too expensive for the average consumer or they may not be able to locate and serve the recipient. A kind of cyber commerce that shows some hope is the selling of downloadable products. Again, the question of customer-service interaction remains. For now, the categories of e-business that show positive trends are mobile-phone-related businesses like bill payment, prepaid services, and, to a certain extent, downloadable materials.^{27,28} Figure 7 gives an overview of the size of business activity registered in cyberspace of Central Africa.

²⁷ Sam Moss, "FirstRand Expands Further In Africa," *First Rand*, March 30, 2005, accessed June 29, 2012, <http://www.firstrand.co.za/content/291/firstrand-expands-further-in-africa/>.

²⁸ Anna McGovern, "Afrique : transferts d'argent au bout du fil," *Africa Time*, February 21, 2012, accessed August 23, 2012, http://africatime.com/Tchad/nouv_pana.asp?no_nouvelle=654037&no_categorie=3.



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Figure 7. ECCAS Cyberspace Business and Industries Import/Export

F. SOCIETY

ECCAS social interaction with ICT is quite complex. On the one hand, there is a high penetration of mobile phones, which makes it possible for people of all ages and levels of education to be “connected.” However, even though mobile communication devices are well spread into the population, their use remains limited to calling and texting; services that involve data-package exchange are far behind. Internet services, in the other hand, are a strong utility tool used by many people. The younger generation uses them for entertainment, social networking, and e-mail exchange. In the academic world, the Internet is becoming a genuine tool for accessing world knowledge and exchanging information within national and regional universities.²⁹ In the professional world and public services, companies as well as administrations are progressively connecting to the Internet, offering more services to their personnel and customers; but this trend is limited by inadequate infrastructure, bandwidth, and the expense of end-user connectivity equipment.³⁰ Figure 8 shows the penetration of cyber related activities (Internet user, Facebook user, online media freedom) in the society. What comes first usually is electronic mailing services, as they offer speed and quality to materials exchange, unlike aging faxes that randomly fail to transfer, when they even exist. Although some countries are moving to ATM systems for customers to retrieve money from their bank account, monetary deposits through automatic systems or automatic sales of merchandise are yet to be introduced (see Figure 7). The reliance on ICT for daily activities in private or public companies within the ECCAS region is not yet critical. Though certain companies do have information systems, they remain supplemental rather than core assets. In rural areas, apart from mobile-phone services that have found their way to the countryside, the Internet and all the other electronic services are notably absent and when they do exist, the service is poor and erratic. The news media, especially

²⁹ Emmanuel Tonye, “La formation continue et à distance (FOCAD) en Afrique centrale: étude de faisabilité contextualisée,” *AUF-RES@TICE Report*, May 2008, accessed August 25, 2012, <http://www.resatice.org/IMG/pdf/tonye.pdf>.

³⁰ Glen Farrell and Shafika Isaacs, “Survey of ICT and Education in Africa: A Summary Report, Based on 53 Country Surveys,” *Washington, DC: infoDev / World Bank*, 2007, accessed August 23, 2012, <http://www.infodev.org/en/Publication.353.html>.

the press, has discovered in the Internet an excellent tool to overcome censorship of their releases. As a matter of fact, there is a blossoming trend of opposition (alternative) news agencies with websites, online blogs, and online-social-media discussions, generally hosted, animated, and nurtured from outside the country through the aid of diasporas and civil-rights organizations.³¹

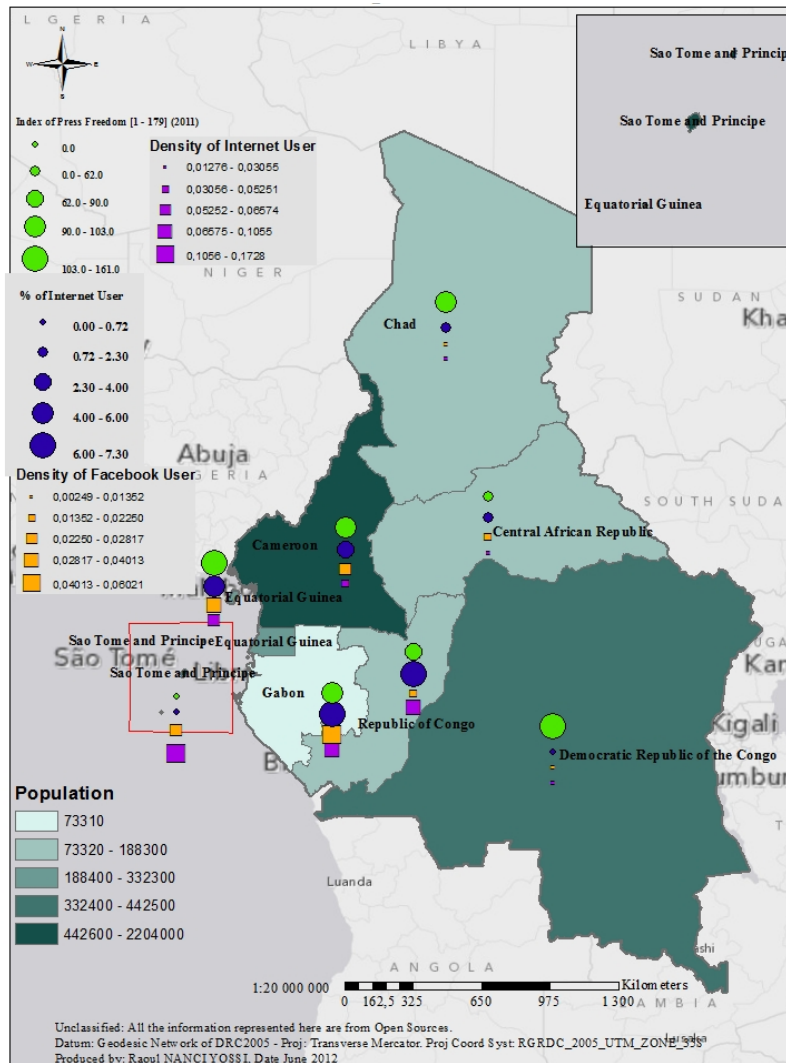


Figure 8. ECCAS Internet Usage and Penetration

³¹ “Central African Republic: ‘La Facebookmania’ à La Centrafricaine,” *Oafrica*, accessed August 24, 2012, <http://www.oafrica.com/city-profile/central-african-republic-facebookmania/>.

G. CONCLUSION

Overall, the level of penetration of IT in the ECCAS region is low in comparison to the world standard and relative to its population size. The dependency on technology in daily life is thus insignificant. Nevertheless, the trend of advancement is positive and multiple efforts are underway to sustain this trend, as it is believed that ICT can help poor countries improve their economic conditions.

The lack of efficient cyberspace use in Central Africa affects the economy and increases poverty while undermining state power in the region. The end of the year 2012 will see the accomplishment of many projects aimed at developing information and communication infrastructures in Central Africa.³² Although the very existence of these projects is a good thing for the development of cyberspace in the region, numerous challenges exist. Economic difficulties and multiple sociopolitical crises tend to give an inconsistent development pattern to ICT movement. Countries have different approaches: some do merely nothing while others strive to start somewhere, but without needed resources or a coherent strategic plan. The result of these inconsistencies is the increase of risks and distrust in Central African cyberspace and the perception of cyberspace as a threat to the state and national security. Leading decision makers look at the development of cyberspace as a secondary matter, a luxury reserved for Western countries that Africans are not really ready for. Challenges that show up may be (but are not limited to) the following points.

³² The Central African Backbone project that intend to interconnect Cameroon, Chad, and Central Republic of Africa will be achieve this in 2012, additionally these countries are all constructing internal optical fiber networks and others information's systems projects. See "Central African Backbone Project - APL1A in Chad: Harmonization and Modernization of the Legal and Regulatory Framework for Electronic Communications," *World Bank – WB DEVEX*, July 28, 2010, accessed June 22, 2012, <http://www.devex.com/en/projects/central-african-backbone-project-apl1a-in-chad-harmonization-and-modernization-of-the-legal-and-regulatory-framework-for-electronic-communications>.

African rulers seem to be blinded by misconceptions and hype over the danger of the cyber realm, to the extent that real progress in ICT is the result of a private sector in search of new markets and consumers around the world—despite all the academic research that shows the importance of ICT in the fight against poverty.^{33,34} Although it is true that cyberspace presents some real risks to users, the many examples of socioeconomic growth observed in other areas of the world with the support of that realm show that this may also be possible in Central Africa.³⁵

³³ Brahim Sanou, “The Role of ICT in Advancing Growth in Least Developed Countries: Trends, Challenges and Opportunities,” *ITU- Telecommunication Development Bureau*, 2011, accessed August 23, 2012, <http://www.itu.int/pub/D-LDC-ICTLDC.2011>.

³⁴ Yayehyirad Kitaw, “E-Government in @frica: Prospects, challenges and practices,” *International Telecommunication Union*, November 2006, accessed June 11, 2012, http://people.itu.int/~kitaw/egov/paper/E-Government_in_Africa.pdf, 6.

³⁵ Nnaemeka Ewelukwa, “Is Africa Ready for Electronic Commerce? A Critical Appraisal of the Legal Framework for Ecommerce in Africa,” *ACICOL Conference Paper*, January 14, 2011, accessed August 23, 2012, http://www.acicol.com/__temp/Dr_N.pdf, 3-6.

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III. THE CHALLENGE OF CYBER INTELLIGENCE IN CENTRAL AFRICA

A. INTRODUCTION

One of the greatest achievements of the twenty-first century is undoubtedly the revolution of information technology; it has made it possible for someone sitting in his shed, far in the extremity of the world—say the equatorial forest in Africa—through a computer connected with a satellite link to access overwhelming capabilities. With the necessary skills and tools, he is capable of actions considered two decades ago as miraculous. Many specialists say that “whatever knowledge someone may want, he will get it.” But to what degree is this statement true? Is all information available online? Does access to online information help one anticipate the next move of one’s neighbor? There are academics who argue that the information technology era has whistled the end of secrecy.^{36,37} In a world where dependency on technology for daily activities is becoming more necessary, the high processing capacity of computers or networks of computers will overcome the existing techniques of protection of information and ultimately expose secrets (protected information) or predict the unknown.^{38,39} To counter these arguments, others scholars object that even though one might access all available data, its overwhelming size will prevent the user from acknowledging the right information at the right time in order to take action accordingly.⁴⁰ The relevance of this debate has a sounding board in the global intelligence community, where the answer to

³⁶ Florini, Ann, “The End of Secrecy,” *Foreign Policy*, N° 111 (1998):50-63, accessed June 9, 2012, <http://www.jstor.org/stable/1149378>, 1.

³⁷ Micah L. Sifry, “In the Age of WikiLeaks, the End of Secrecy?” *The Nation*, March 3, 2011, accessed June 09, 2012, <http://www.thenation.com/article/158988/age-wikileaks-end-secrecy>, 1.

³⁸ Justin Wolfers and Eric Zitzewitz, “Prediction Markets,” *Journal of Economic Perspectives* 18, N° 2(2004): 107–126, accessed June 9, 2012, [http://bpp.wharton.upenn.edu/jwolfers/Papers/Prediction markets.pdf](http://bpp.wharton.upenn.edu/jwolfers/Papers/Prediction%20markets.pdf).

³⁹ Lynn Wu and Erik Brynjolfsson, “The Future of Prediction: How Google Searches Foreshadow Housing Prices and Sales,” *ICIS 2009 Proceedings*, Dec 2, 2009, accessed June 9, 2012, http://pages.stern.nyu.edu/~bakos/wise/papers/wise2009-3b3_paper.pdf.

⁴⁰ Erik J. Dahl, “Warning of Terror: Explaining the Failure of Intelligence Against Terrorism,” *Journal of Strategic Studies* 28, n°1(2005), 46.

the dilemma has direct repercussions on intelligence-collection strategies.⁴¹ The question becomes whether to invest in information-technology techniques for collection and prediction (CYBINT) or to keep developing older techniques base on human interaction for collection and analysis (HUMINT). By CYBINT⁴² is meant all computer and network attacks and exploits made with the purpose, not to disrupt or create harm to computer systems, but to retrieve embedded information.^{43,44} It also encompasses prediction activity based on data stored in databases or available online.^{45,46} This type of activity requires specific skills and training, and generally needs important processing power, such as in code breaking or forecasting analysis.⁴⁷ Although the basic tools for cyber espionage are available online, important infrastructural requirements are generally needed when the stakes become high.⁴⁸ Overall, CYBINT is attractive because it offers limited lethal exposure and a great level of deniability for the performer.⁴⁹ On the other hand, HUMINT, even though reputed as very risky for the performer, is one of the traditional means of information collection. Old as the world, HUMINT is solely based

⁴¹ Hamilton Bean, "No More Secrets: Open Source Information and the Reshaping of U.S. Intelligence," *Center for the Study of Intelligence* 56, No.1, Santa Barbara CA: Praeger 2011, 218, accessed June 9, 2012, <https://www.cia.gov/library/center-for-the-study-of-intelligence/csi-publications/csi-studies/studies/vol.-56-no.-1/no-more-secrets-open-source-information-and-the-reshaping-of-u.s.-intelligence.html>.

⁴² The term CYBINT is an invention of the author in an effort to summarize into one word all the techniques of collecting information base on cyber technology; of course this might encompass some terminology already common in the intelligence community like OSINT for Open Source Intelligence, SIGINT for Signal Intelligence, and CNE/D for Computer Network Attack and Defense.

⁴³ Kevin G. Coleman, "Cyber Espionage Targets Sensitive Data," *SIP Trunking*, December 29, 2008, accessed June 9, 2012, <http://sip-trunking.tmcnet.com/topics/security/articles/47927-cyber-espionage-targets-sensitive-data.htm>, 1.

⁴⁴ John Villasenor, "The Flame Cyber Espionage Attack: Five Questions We Should Ask," *Forbes*, June 04, 2012, accessed June 09, 2012,

<http://www.forbes.com/sites/johnvillasenor/2012/06/04/the-flame-cyber-espionage-attack-five-questions-we-should-ask/>.

⁴⁵ Joe McKendrick, "Search data analysis opens up intelligence gathering," *SmartPlanet*, March 25, 2011, accessed June 09, 2012, <http://www.smartplanet.com/blog/business-brains/search-data-analysis-opens-up-intelligence-gathering/14601>.

⁴⁶ "Intelligent Data Analysis: An International Journal," *IOS Press* 16, N°6, May 9 2012, accessed June 09, 2012, <http://www.iospress.nl/journal/intelligent-data-analysis/>.

⁴⁷ Dorothy Denning, "Computer Network Attack and Defense," (lecture Naval Postgraduate School, Monterey, CA, February, 2012).

⁴⁸ Dorothy Denning, discussions on necessary infrastructure for developing and testing large scale cyber-weapons like STUXNET, in Conflict in Cyberspace, (lecture Naval Postgraduate School, Monterey, CA, February, 2012).

⁴⁹ Denning, "Conflict in Cyberspace."

on man-to-man interaction, where in a cat-and-mouse game, deception, persuasion, coercion, and tricks are used to collect information from targeted individuals. Depending on the theater of operation, HUMINT can be very expensive for its sponsor, due essentially to human greed or the impossibility of total control over informants.⁵⁰ While it is considered a worthwhile and obvious discussion when this debate over CYBINT versus HUMINT takes place in Western countries, there is uncertainty on the value of the same question in African countries. The point of this chapter is to raise awareness on the potential risks of cyber intelligence in the growing cyberspace of Central Africa, and on the flip side, to evaluate the opportunities that are available for intelligence collection by state agencies. Along with this discussion is the place of human intelligence; in the African context, cyber capabilities can provide undeniable support to that form of collection, which is predominant.

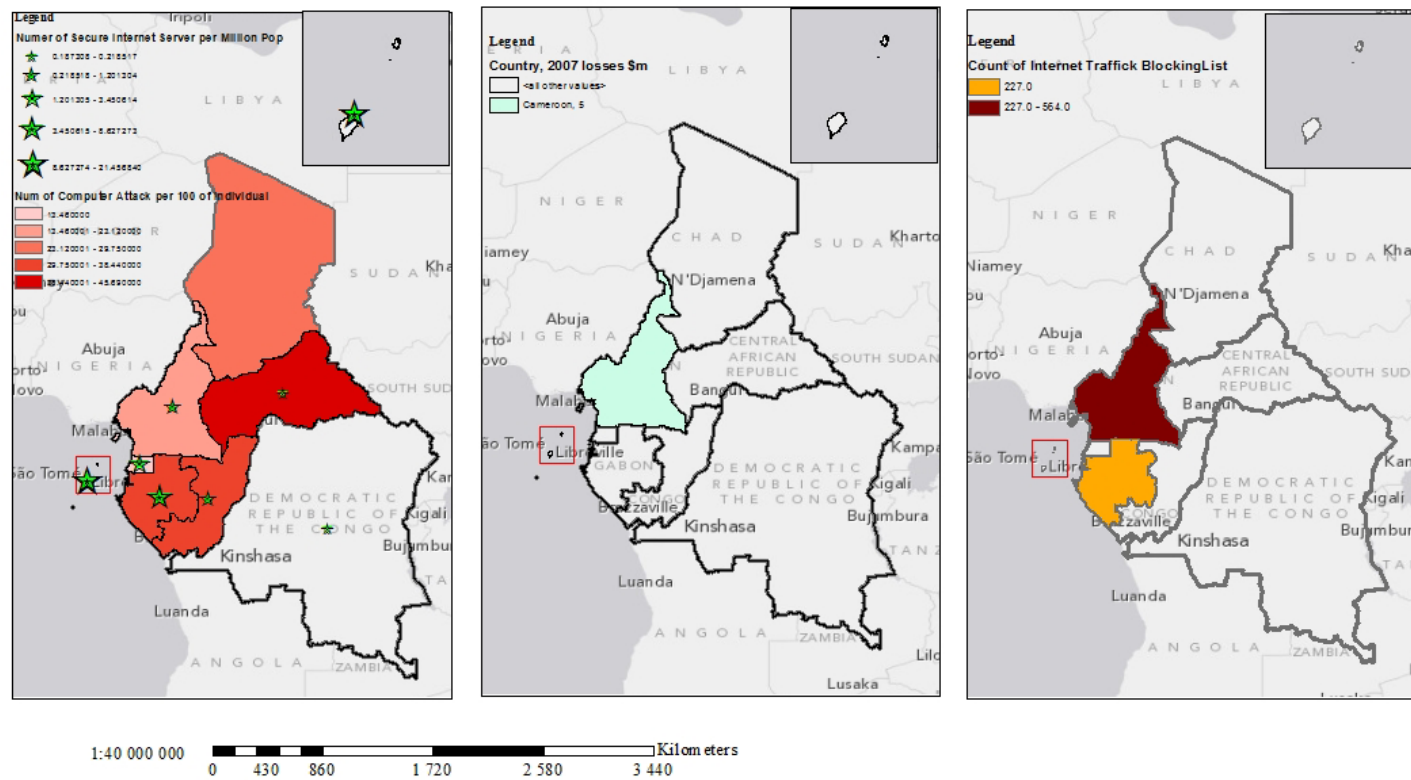
B. THE ROOTS OF THE PROBLEM

Many African nations are still emerging in their incipient walk towards information technology. Global statistics give cyber technology a penetration rate of nearly twenty percent.⁵¹ International telecommunication companies in search of economic opportunities are driving the progress by introducing more and more communication solutions and futuristic devices.

To fill the technological gap, tremendous efforts are deployed by local states to build a suitable technological framework. Due to multidisciplinary needs and extended areas of concern, security aspects are barely addressed or not considered priorities, leading the way to multiple security risks as the criminal activity in the subregion shows (see Figure 9), some of which involve intelligence collection.

⁵⁰ David Tucker, "Intelligence in the Information Age," (lecture Naval Postgraduate School, Monterey, CA, May, 2012).

⁵¹ "Internet Usage Statistics for Africa," *Internet World Stats*, April 26, 2012, accessed June 10, 2012, <http://www.Internetworldstats.com/stats1.htm>.



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Figure 9. ECCAS Criminal Activities in Cyberspace

Indeed, in the absence of operational governmental networks (intranet or secure extranet) or a platform for information exchange, many decision makers and high-ranking administrative personnel share classified data on commercial information systems with their personal accounts. In past years, several incidents have been registered involving intrusion into authorities' mailboxes, identity theft, digital counterfeiting, financial extortion, and more, thus raising the alarm on intelligence-leak possibilities.^{52,53,54} These threats are worsened by a progressing cyberspace capability and ignorant users who are not fully trained in newly introduced technology.

In such a context, where “defense” is barely developed, Africa’s intelligence community will certainly view the regional cyberspace as a gold mine for intelligence collection and might want to give up the human side, with all its defects and flaws, to increase their cyber-collection assets. But will it not be discarded too quickly? Does CYBINT really hold the promise of its flowers? Would it not be another hype like the Year 2000 (Y2K) computer bug? The end of the world promised a few decades ago was to come from computers. In a world where dependency on cyber would be at a hundred percent, such a scenario could be conceivable; but in Africa, based on its complex picture and the low level of cyber penetration, cyber-intelligence collection can only be a supplement to old techniques that put the individual, the human relationship, at the center of the collection effort. Nevertheless, because of the weakness of “defense,” those engaged in intelligence collection should not disregard cyber capabilities, nor disqualify human-based techniques already existing, but should consider a combined approach where cyber collection can help build the intelligence background. Occasionally, cyber means provide firsthand knowledge while human-based collection techniques complete the background with missing links, help unlock secure data collected through cyber means, or guide the analyst through the massive amount of information available in cyberspace.

⁵² Dirro Toralv, et al., “McAfee Threats Report: Second Quarter 2011,” *McAfee® Labs*, accessed June 2012, <http://www.mcafee.com/us/resources/reports/rp-quarterly-threat-q2-2011.pdf>, 13-17.

⁵³ Franz-Stefan Gady, “Africa's Cyber WMD,” *Foreign Policy*, March 24, 2010, accessed June 2012, http://www.foreignpolicy.com/articles/2010/03/24/africas_cyber_wmd?page=0,0.

⁵⁴ Issa Sikiti, “Africa: Cybercrime Increase Worries, Vulnerable Groups Targeted,” *All Africa*, September, 29 2011, accessed June 10, 2012, <http://allafrica.com/stories/201109290659.html>.

According to the available indicators of information-technology development in World Bank, World Economic Forum, and International Telecommunication Union statistics, sub-Saharan African countries are at the bottom in terms of readiness, usage, environment, and socioeconomic impact.^{55,56,57} The reasons for their primitive information systems range from politically unstable environments to poverty and social conditions. Obviously, information and communication technology was not a priority in the continent during the past decades; since then, multiple factors have forced African states to embrace ICT, generally without fully preparing the society for it. International companies in search of new markets are invading the subregion, going after a population of than a billion inhabitants.⁵⁸ Unfortunately, this aggressive penetration happens in a context where the average level of education and literacy is very low, the cultural perception of technology still naïve, and the legal packages on ICT inadequate where it exists at all.^{59,60} A high level of technology is thus unavailable to the population, which barely understands its potential and as a consequence, uses it awkwardly. Many of the cyberspace devices commonly available are not well understood by users. The argument that prevails is that they help to perform a good job, or that these devices are fashionable.

Globalization also contributes to the rush toward technology. People everywhere need to communicate and communicate faster. When a fax machine presents difficulties,

⁵⁵ Ewan McPhie, "Building capacity to narrow the digital divide in Africa from within," *World Economic Forum-NEPAD E-ReadinessPolicy Programme*, January 7, 2003, accessed June 10, 2012, http://old.apc.org/english/capacity/policy/mmtk_ictpol_humanrights_ereadiness.pdf, 12.

⁵⁶ Soumitra Dutta and Beñat Bilbao-Osorio, "The Global Information Technology Report 2012: Living in a Hyperconnected World," *World Economic Forum*, accessed June 10, 2012, http://www3.weforum.org/docs/Global_IT_Report_2012.pdf, 197.

⁵⁷ Princely Ifinedo, "Measuring Africa's e-readiness in the global networked economy: A nine-country data analysis," *International Journal of Education and Development using Information and Communication Technology (IJEDICT)* 1, N° 1, 2005, 53-71.

⁵⁸ Acobo Garcia-Palencia, Juan Jose Rio, and Dimitris Lioulis, "ICT in Emerging Markets: A USD 200 BLN OPPORTUNITY THAT CANNOT BE IGNORED," *Delta Partners – White Paper*, May 2011, accessed June 10, 2012, <http://www.deltapartnersgroup.com/ict-in-emerging-markets-a-usd-200-bln-opportunity-that-cannot-be-ignored>.

⁵⁹ "Internet Usage Statistics for Africa," *Internet World Stats*, April 26, 2012, accessed June 10, 2012, <http://www.Internetworldstats.com/stats1.htm>.

⁶⁰ "Draft African Union Convention on the Establishment of a Credible Legal Framework for Cyber Security in Africa," *Africa Union Economic Commission*, Draft Version 01/01.2011, accessed June 10, 2012, http://www.uneca.org/aisi/elegislation/documents/Draft_Convention_on_Cyberlegislation_in_Africa_Draft_0.pdf.

users hurry to e-mail as a stopgap: “scan it and e-mail to my Yahoo account!” E-mails are inexpensive and reliable in terms of quality of service, while SMS, chat rooms, and voice-mail are easy in a context where postal services are sometimes unreliable, expensive, or nonexistent. In the global world, the concept of “time is money” applies everywhere; business, administration, military, and others stuck in the countryside are obliged to use any practical means available to quickly satisfy their communication needs.

One other motivation for penetration of ICT is the growing population and the needs that come with it. Governments are forced to embrace ICT because it provides solutions to handling an increasing amount of data, including the number of civil servants, the electronic-voting system, the social-security registration system, the ID-card system, the driving-license system, the birth-registration system, and many others. Needs are numerous and only technology offers reliable answers. African governments have recognized in information technology a powerful solution to overcome poverty through the improvement of communication and management of large amounts of information.⁶¹ Thus, they have put the development of ICT in the list of priorities and encouraged their population to migrate towards it.⁶² National policies have been crafted to guide the endeavor; but when one looks closely at these policies, the principal topics of discussion are education, infrastructure, services, and promotion of usage.^{63,64} Very little, if anything, is said on security. When security is mentioned, it is generally a global concept rather than a set of straightforward, applicable policies.

⁶¹Stuart Mathison, “ICT For Poverty Reduction: Myths, Realities and Development Implications,” *Part II: ICT4D Forum Proceedings, Canada’s International Development Research Centre (IDRC)*, September 2003 accessed June 10, 2012, http://www.gersterconsulting.ch/docs/ict4d_book_part_7_ict_for_poverty_reduction.pdf.

⁶²“National ICT Strategy,” *IST-Africa Initiative*, accessed June 10, 2012, <http://www.ist-africa.org/home/default.asp?page=doc-by-id-print&docid=2880&>.

⁶³“ICT policy priorities in Africa,” *Association For Progressive Communications*, accessed June 10, 2012, <http://www.apc.org/en/blog/ict-policy-priorities-africa>.

⁶⁴“ICT in Africa: Boosting Economic Growth and Poverty Reduction,” *Africa Partnership Forum in Tokyo*, April 2008, accessed June 10, 2012, <http://www.oecd.org/dataoecd/46/51/40314752.pdf>, 6-8.

C. CYBER INTELLIGENCE OPPORTUNITIES

In many administrations, there is a dilemma between the need to access information for the purpose of efficiency and the need to protect secrets and ensure privacy. Usually, in the local context, the absence of regulation and the pressure of results will push decision makers to take the risk of deploying internal networks, which generally are exclusively wireless and rely on free, online messaging services for content exchange. To make things worse, generally no one in these organizations is trained in computer security awareness, or if so, the ratio per number of personnel is very low. Such behavioral patterns are witnessed even at the top levels of government institutions.⁶⁵

In the military, as in other security services, the situation is not much different. Information technology has not yet penetrated these services at the level of operations or command-and-control systems. IT is essentially used in an administrative context as a tool to enhance performance. It is thus used for bureaucratic purposes, such as human and logistics resources management, or headquarters paperwork. As in other administrations, there is a tremendous outbreak of personal computer usage at the individual level, for example, the office-secretary level. The inherent risk here is their use of the Internet, which is welcomed as a means of communication and document exchange. Unfortunately, there is a negative and calamitous mixture of personal with official activities. One is not surprised to find on personal and privately owned computers sensitive documents, which are exchanged over the Internet. It is not uncommon to find the secretary of a high-ranking official using her computer—the very same one that is meant for sensitive work—to spend long hours chatting online on social-network websites.

This lack of security concerns was probably justified by the almost nonexistent or very low penetration of cyberspace and multiple other areas of preoccupations. Due to the need to start somewhere, decision makers did not have any reason to perceive cyberspace as a threat. In fact, up to that stage, it did not represent a security risk; on the contrary,

⁶⁵ Personal experience of the author.

cyberspace was viewed, and is still viewed, as a catalyst to development.⁶⁶ The emerging use of cyberspace is increasingly showing sources of security risk tied to the very nature of this realm: identity theft, extortion, information leakage, and other wrongdoing. Some governments are acting to catch up, passing new laws, creating regulatory boards, seeking counseling, and enacting other measures.^{67,68} But these initiatives are still very weak and insufficient compared to the rate of growth of cyberspace. Many obstacles have still to be overcome, such as lack of qualified enforcement personnel, financing resources, infrastructure, forensics equipment, and organization.^{69,70}

Surprisingly, there is a fraction of people that, due to their exposure to globalization and consciousness of the sensitivity of information they are in charge of, take measures at the personal level to guarantee their safety. These measures go from the use of highly secure passwords and separate computers for sensitive matters that will never be connected online, to strong encryption. Although these people show the right attitude, they still are embedded in an insecure environment that minimizes the chances of success.

In this atmosphere of low security practices, the “defense” obviously is at a disadvantage; any technically savvy person will immediately sense the possibilities of cyber espionage, especially when one realizes that it is those who retain valuable information—the middle and upper class—who are generally accessible through

⁶⁶ Yayahyirad Kitaw, “E-Government in @frica: Prospects, challenges and practices,” *International Telecommunication Union*, November 2006, accessed June 11, 2012, http://people.itu.int/~kitaw/egov/paper/E-Government_in_Africa.pdf, 6.

⁶⁷ “Cameroon Urged to Act Against Cybercrime; Government proposes stricter monitoring of Internet,” *Voice Of America News*, February 09, 2011, accessed June 11, 2012, <http://www.voanews.com/content/cameroon-Internet-scamming-10feb11-115732229/159740.html>.

⁶⁸ Rebecca Wanjiku, “Rising Cybercrime Pushes African Governments to Take Action,” *CSO Online*, December 19, 2011, accessed June 11, 2012, <http://www.csoonline.com/article/696806/rising-cybercrime-pushes-african-governments-to-take-action>.

⁶⁹ Eric Agwe-Mbarika Akuta, Isaac Monari Ong’oa, and Chanika Renee Jones, “Combating Cyber Crime in Sub-Sahara Africa; A Discourse on Law, Policy and Practice,” *Journal of Peace, Gender and Development Studies* 1, N°4, 129-137, May 2011, accessed June 11, 2012, <http://www.interestjournals.org/JPGDS/pdf/2011/May/Akuta%20et%20al.pdf>, 131-136.

⁷⁰ Bankole Orimisan, “Forensics Experts Canvass Speedy passage of Cyber Security Bill,” *The Guardian*, May 23, 2012, accessed June 11, 2012, http://www.nguardiannews.com/index.php?option=com_content&view=article&id=86917:forensics-experts-canvass-speedy-passage-of-cyber-security-bill&catid=55:compulife&Itemid=391.

cyberspace.⁷¹ One could guess that the intelligence community might be charmed by this cheap and unrisky potential source of information collection. The reality is difficult to tell—not much documentation exists on the matter, whether of existing cases of cyber-intelligence collection or on policies crafted to lead intelligence collection in that direction. What is certain is that the same illnesses that infect African state organization also infect their intelligence community: low levels of awareness, lack of technically savvy personnel (in quality and quantity), limited equipment, and lack of clearly define policies for cyber-asset utilization.^{72,73} What is interesting is that cyber spying is in some respects very cheap and easy to acquire or develop.⁷⁴ It would probably take less time to develop than to put in place an acceptable defensive posture.

Assuming the existence of directives and means to conduct cyber-based intelligence collection, it is not easy to predict how effective it would be. Based on the degree of penetration of IT in African society, one can think essentially of two broad categories of information open to intelligence collection. First, the background: like a new fashion that comes and goes, ICT is nowadays considered a “must have,” and cyberspace “the place to be!” News media, organizations, administrations, businesses, everyone that can afford it goes online, giving to those interested in information gathering the luxury of collection. Missing the necessary security awareness, ICT users do not take

⁷¹ Yayahyirad, “E-Government in @frica: Prospects,...,” 20–21.

⁷² Personal experience of the author.

⁷³ Victor Ndonnang, “Internet Society’s new Chapter in Cameroon already off to a successful start,” *Internet Society Newsletter* 10, N°07, July 6, 2011, accessed June 12, 2012, <http://www.internetsociety.org/articles/internet-society%E2%80%99s-new-chapter-cameroon-already-successful-start>.

⁷⁴ Dorothy Denning, “Computer Network Attack and Defense,” (lecture Naval Postgraduate School, Monterey, CA, February, 2012).

basic precautions before going online. This results generally in unfiltered information posted online, complete profiles published in chat rooms and social media, and sensitive matters discussed via cyber media. For this reason, when available online, background data can be dramatically accurate. The second type of information one can find online is operational. This is when key players (individuals in organizations) in certain events use their cyber devices to exchange information with the world, exposing themselves or their institutions to information leak or theft. This can be a gold mine. Indeed, the absence of regulation on handling sensitive data, the false privacy of a personal device, and undue confidence in a personal account presumed to be well protected by a strong password and in unlicensed security software can lead people to store and exchange data online.

D. THE ROLE OF HUMAN INTELLIGENCE

These phenomenal and appetizing opportunities have unfortunately multiple limitations when narrowed to the African context. The first to think of is the small-scale of targets. Not everyone has a computer or goes online. Most of the cyber activities are concentrated in urban areas; the rural areas and countryside are still out of the loop.⁷⁵ The idea of absolute knowledge based on cyber penetration is therefore unrealistic. The second argument, which relates to the first, is that not all information is online. Although there is incentive in all sectors to go online, there is still much work to do. IT is still at its inception, and many of the archives dating from more than fifty years of existence for most African states are yet to be digitalized. The third reason is the mistrust of critical decision makers towards the use of cyber assets; being generally of the old school, they do not have a good understanding of how it works. They are thus obliged to request assistance in going cyber, e.g., initiating a cyber conference, sending e-mail, and operating encryption steps. They believe such needs unnecessarily increase layers in the information pipeline and perceive any technical intermediary who does not possess the necessary security clearance as a probable source of leakage. Fourth, and not final, in this non-exhaustive list is the paranoid attitude of some key players who may hold sensitive

⁷⁵ Soumitra et al., “The Global Information Technology Report 2012: Living in a Hyperconnected World,” 200.

information and also use cyberspace. This category of individual tends to put considerable individual base protection layers over his secrets, such as encryption, isolation of electronic devices, and deception.

Though the cyberspace picture in sub-Saharan Africa is complex, cyber means of collection cannot be dismissed. Many barriers do exist, but it is hard for the intelligence community not to consider the potential cyberspace offers by the lack of an organized cyber defense strategy at the moment when everyone is embracing cyberspace.

From a general perspective, two scenarios unfold when collecting intelligence from cyberspace. Either one may not find all the information needed (it may be protected by secure lock) or there may be too much data available, which will ultimately lead to confusion or waste of time. Either way, human intervention proves itself necessary for analysis, triage, or to provide missing links.⁷⁶ One other way to combine human intelligence collection with cyber techniques is the use of social engineering and spying techniques, good terrain preparation, and study of individual habits, to locate and access protected cyber assets holding sensitive secrets. Information protected with strong encryption can take an exorbitant time to unlock through computation techniques; meanwhile, the involvement of human assets can ideally provide keys to unlock this data.⁷⁷

In sub-Saharan Africa, as in most developing countries, human intelligence is the principal means of intelligence collection. Intelligence is collected through the use of human infiltration of enemy lines, informants, exploitation of prisoners, and similar techniques. Being the predominant means of collection for decades, the intelligence community in Africa is well grounded in human intelligence and is not likely to move from it. For cultural, educational, and technological reasons, human intelligence will remain the main focus. When it comes to background-information gathering, cyberspace techniques will certainly provide initial help. Cyber-surveillance tools will certainly be added, to the extent of their affordability, to the toolbox of the intelligence community.

⁷⁶ Tucker, "Intelligence in Information Age."

⁷⁷ Denning, "Computer Network Attack"

E. CONCLUSION

Cyberspace in Africa is experiencing exponential growth, driven essentially by economic factors. The number of topics of concern regarding cyberspace are many, from infrastructure, laws and regulations to quality of service and security; in such a context, security is one of the least areas of concern. For the intelligence community, a cheap source of information has become available, due to all the misuses and unachieved steps of cyberspace development. Already burdened by the overall economic difficulties of the region and the risk of exposure of their human assets, the temptation to redirect intelligence collection efforts to cyberspace can be real. As discussed previously, that temptation has to be delayed or taken with caution. Multiple factors are in play, among which are the low level of cyberspace penetration and dependency on technology and the barrier posed by encryption and system isolation. But rather than dismissing cyber-intelligence collection, it is necessary and good for the intelligence community to acknowledge the potential of cyberspace, develop capabilities in that realm, and use that means of collection in combination with traditional techniques.

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IV. THE ROLE OF GOVERNMENT IN CYBERSPACE

A. INTRODUCTION

An ungoverned cyberspace poses a broad range of risks to the national security of a country. These risks go from system disruptions, cyber-intelligence leaks, and cyber terrorism to economic losses and many other issues not discussed in this chapter.^{78,79} These risks prompt the need for some entity to guarantee safety and security to actors in cyberspace. Usually, the exercise of authority can be offered in multiple forms and by several types of entities, but in the case of cyberspace, where the consequences of actions are deeply tied to events and infrastructure in the physical world, some aspects of this authority are most likely to devolve to the state and *de facto* to its government.^{80,81}

Generally, problems that start in the realm of bits and bytes end up in the hands of real people in the real world, and result in requests for real compensation. Solutions are provided by the social mechanisms of the physical world, where state structures (justice, parliament, and executive bodies) are the master players. The repercussions of cyber-domain activities in the physical domain compel state actors to have a presence in the cyber domain in order to exercise power over it.

Evidently, this course of action is being observed everywhere in the world; states legislate on cyberspace, developing abilities to enforce new laws and even transforming that realm into a source of national power. All the cases witnessed around the world make it obvious that states have a role to play in cyberspace, as they already do in the physical world. But the patterns of development of this role differ from one state to another.

⁷⁸ Steven Beardsley, "Cyber weapons growing concern in hyper connected world, experts say," *Star And Stripes*, February 5, 2012, accessed February 12, 2012, <http://www.stripes.com/news/cyber-weapons-growing-concern-in-hyper-connected-world-experts-say-1.167780>, 1.

⁷⁹ Issa Sikiti, "Africa: Cybercrime Increase Worries, Vulnerable Groups Targeted," *All Africa*, September 29, 2011, accessed June 10, 2012, <http://allafrica.com/stories/201109290659.html>.

⁸⁰ Rebecca Wanjiku, "Rising Cybercrime Pushes African Governments to Take Action," *CSO Online*, December 19, 2011, accessed June 11, 2012, <http://www.csoonline.com/article/696806/rising-cybercrime-pushes-african-governments-to-take-action>.

⁸¹ James Geary, "Who Protects the Internet?" *Popular Science*, April 2009, accessed April 03, 2012, <http://www.popsci.com/scitech/article/2009-03/who-protects-internet>.

Although there is a general trend to go in the same direction, the patterns of involvement of states in cyberspace remain diverse and even unclear, particularly in Africa.

In fact, in Central Africa it is unclear whether there is a unanimous vision of the state's role in cyberspace. This might be due to the fact that the penetration rate of that realm is not the same everywhere, with some countries at the bottom of the cyber-readiness index and others starting to discover the potential of cyberspace—along with its dangers. Cyberspace and the cyber technologies that go with it are fast-evolving domains, where concepts and capabilities change rapidly to become obsolete and dangerous to their users when they do not update. In this rapidly growing context, where boundaries are extremely fuzzy and most of the premises to be settled, it is more than crucial to examine what role the states in Central Africa have to play in cyberspace, given their socioeconomic and political reality.

The point this chapter would like to make is that, given that actors in the cyber realm are primarily human beings (although some are artificial intelligence)—who give life, command and control to bytes—cyberspace is just an extension of the human existential plan, and thus is part of human society. The mechanisms that human societies have developed to live together should just be extended to this new realm and adapted to its reality. The state, which is representative of its communities, should therefore naturally exercise authority in cyberspace for matters that are relevant to its competences. Due to the nature of the cyber realm, with the extension of the state role comes inherent challenges, like boundaries, the universality of laws, authentication, and others. In Central Africa, these challenges are exacerbated by other variables tied to socioeconomic and political issues. To examine the role of states in the cyberspace of the ECCAS, one may use the framework of the diplomatic, informational, military, and economic (DIME) forms of power as it fits to the areas of power that states naturally possess.⁸²

The analysis of state roles will be conducted first by looking at state objectives, second by discussing the modes of action that exist within the instruments of power, and

⁸² Richard J. Josten, "Strategic Communication : Key Enabler for Elements of National Power," *IOSphere*, summer 2006, accessed August 23, 2012, http://www.carlisle.army.mil/DIME/documents/iosphere_summer06_josten.pdf, 1.

finally by contemplating expected results in critical areas of cyberspace. Little emphasis will be made on military roles in the context of the limited resources that Central Africa suffers.

B. STATE OBJECTIVES IN THE CYBERSPACE OF CENTRAL AFRICA

In the growing context of ICT in Central Africa,⁸³ multiple actors exist and contribute momentum. The business segment with IT service operators who are competing to provide their best and collect maximum revenues; private institutions that have their personal agenda and use ICT for that purpose; criminals that take advantage of flaws in the system to gather wealth; populations who are the principal consumers of ICT and thus the target of online predators; and the states whose interests are diverse and generally ambiguous. In this context, states have the most complex role in cyberspace. All who use ICT, particularly the virtual world of the Internet, when they are frustrated by the outcome of their interaction with other individuals or entities encountered in the cyber realm, seek help or arbitration from the state. In the ECCAS region, the burgeoning reality of cyberspace is accompanied by a trend of side effects like frequency allocation, domain-name conflict, infrastructure sharing, identity theft, privacy invasion, and so on, that call for state intervention. Software counterfeiting and piracy represent a source of tax losses and revenues for both IT companies and the state. Although they are still low, thanks to the fact that the cyberspace is still nascent, criminal activities and dysfunction in cyber compartments are already noticeable.⁸⁴

⁸³ “Internet Usage Statistics for Africa on December 31, 2012,” *Internet World Stats*, April 26, 2012, accessed June 10, 2012, <http://www.internetworldstats.com/stats1.htm>.

⁸⁴ “Cameroon Urged to Act Against Cybercrime; Government proposes stricter monitoring of Internet,” *Voice Of America News*, February 09, 2011, accessed June 11, 2012, <http://www.voanews.com/content/cameroon-internet-scramming-10feb11-115732229/159740.html>.

As a result of their need to improve services to the population and the obligation to foster the economic prosperity of their people, states are also consumers of ICT services. Because of the anarchical development and penetration of ICT in state institutions, a serious potential for intelligence leaks or collection exists. The lack of suitable structures to manage domain names makes it possible for criminals around the world to build websites using segments of domain names reserved for ECCAS countries and offer illicit services, creating a dent in the region's reputation.^{85,86} The capabilities that offer cyber technologies make it possible that a lawless segment of cyberspace can be the point of departure for cyber attacks on targets even outside the ECCAS region, with the attackers having the option to vanish without a trace. Cyber terrorism thus becomes a possible threat to ungoverned cyberspace. These anomalies and others not discussed here represent serious challenges for the smooth functioning of a society, as they undermine peace in cyberspace. Cyberspace, as a realm without boundaries, requires international collaboration and the involvement of a national authority for negotiation at the country level, roles which suit the characteristics of a state.

C. STATE ELEMENTS OF POWER APPLIED TO THE CYBERSPACE OF CENTRAL AFRICA

If the state's role and presence in cyberspace seems obvious and even necessary, the approach to implement this role has been different across the world, in the ECCAS region in particular. The numerous priorities that the economic context generates make it an unpopular topic for decision makers and academics. But to deal with the growing size of cyberspace in the ECCAS region and tackle the rising trend of security concerns that naturally come with it, states need to increase their grasp of the domain. States can achieve that goal by using elements of power (diplomatic, informational, military, and

⁸⁵ Andy Greenberg, "Cameroon's Cybercrime Boom," *FORBES*, 12.02.09, accessed June 14, 2012, <http://www.forbes.com/2009/12/01/cybercrime-mcafee-spyware-technology-cio-network-cameroon.html>.

⁸⁶ In Sao Tome and Principe a member of the ECCAS community, the country domain name is not yet administrated by local authorities; a Sweden company does manage it. This situation has led to illicit use of the official domain name of STP for inappropriate web services across the world, like Sex Telephony (.ST), or Style.

economic) that already operate for other areas of concern.⁸⁷ A deployment of these elements of power in the cyber realm one help the states keep the upper hand.

1. Political and Diplomatic

In the diplomatic arena and in a larger sense the political, states have a role of national mobilization. Cyberspace in Central Africa is still in its infancy. To sustain the awakening process, there is a need to gather national resources. States have to find resources for the required investments in infrastructures and education. There is a need to create a collective interest in cyberspace and raise awareness of the advantages and dangers that exist within it. Such a mobilization can only be made at a national level, through the state. If politicians are able to create debate around the topic of cyberspace, people will be more inclined to understand the requirements that are necessary to develop that realm. Thus it will be easier to prioritize a fiscal budget for that purpose. The cyber realm is reputed not to have boundaries when it comes to its contents; this aspect raises some sovereignty issues when materials that can be damageable to the image of a country are released or when malicious actors operating outside the physical boundaries of the state threaten the interests of individuals.⁸⁸ The need to address these issues that are out of a state's jurisdiction requires diplomacy with neighbors and countries across the world. Additionally, the need to benefit from international infrastructure (the network backbone), or to open national infrastructure to the wide space of the world requires an international standard, prompting an active diplomatic role for states within the international community and an authoritative, regulatory, and organizational role within their country. An active diplomacy towards technology transfer would also help African states improve their cyber readiness and provide citizens protection against possible threats. Cyberspace represents a realm where individual liberties are at great risk. It is very common for rogue actors, business companies, and state actors—intelligence—to

⁸⁷ Richard J. Josten, "Strategic Communication : Key Enabler for Elements of National Power," *IOSphere*, summer 2006, accessed August 23, 2012, http://www.carlisle.army.mil/DIME/documents/iosphere_summer06_josten.pdf, 1.

⁸⁸ Eneken Tikk, Kadri Kaska, and Liis Vihul, "Chapter: Estonia 2007," *International Cyber Incidents: Legal Considerations*, (Tallinn, Estonia, Cooperative Cyber Defence Centre of Excellence, 2010), accessed February 12, 2012, <http://www.ccdcoe.org/publications/books/legalconsiderations.pdf>.

cross the line between public and private space.^{89,90} As guarantors of civil liberties, states have an obligation to protect the people. These issues are even more emphasized in the Central African region, where the average level of education is very low and IT is penetrating at a very fast rate, leaving users defenseless. The need for protection of individual liberties in cyberspace requires the state to provide adequate regulations and mechanisms. One mechanism that totally depends on the state is law enforcement; it only exists if the state puts it in place and allows law-enforcement agencies to operate independently.

2. Information

The second element of power that states can rely on to establish their presence in the cyber realm is informational power. IT can make the difference in improving mass-media communication. Indeed, as mentioned earlier, populations not only expect states to provide a framework for cyberspace to operate, they also expect certain services. Some services can be effectively improved with the contribution of IT. In fact, providing a computerized platform for public access to state services and information has proven very positive for quality of life.⁹¹ In a context where access to information is very difficult, generates a lot of dissatisfaction, and lets people bend the laws, an increase in the information-access ratio within a state can be a tremendous source of credibility for the government and a natural means to fight corruption.⁹² States can also benefit from the use of cyberspace to increase their public-relations outreach. Through strategic communication policies waged in cyberspace, where the necessary investment can be relatively cheaper than a physical public-relations deployment, states can draw world

⁸⁹ “Did the Internet Kill Privacy?” *CBSNews*, February 6, 2011, accessed August 24, 2012, http://www.cbsnews.com/2102-3445_162-7323148.html?tag=contentMain;contentBody.

⁹⁰ Chris Irvine, Damien McElroy, “Iran confirms Flame virus attacked computers of high-ranking officials,” *The Telegraph*, May 30, 2012, accessed August 24, 2012, <http://www.telegraph.co.uk/news/worldnews/middleeast/iran/9298935/Iran-confirms-Flame-virus-attacked-computers-of-high-ranking-officials.html>.

⁹¹ Robert D. Atkinson and Daniel D. Castro, “Digital Quality of Life: Understanding the Personal & Social Benefits of the Information Technology Revolution,” *Information Technology and Innovation Foundation*, October 2008, accessed August 24, 2012, <http://www.itif.org/files/DQOL.pdf>, 15.

⁹² Tino Schuppan, “E-Government in developing countries: Experiences from sub-Saharan Africa,” *Government Information Quarterly* 26:2009, accessed August 24, 2012, http://www.ifg.cc/_pdf/GIQ_E-Government_in_developing_countries.pdf, 118–127.

attention to regional attractions and generate tourism, economic investors, or simply positive awareness of their internal situation. At the local level, in a more practical sense, the national mobilization discussed previously will never be totally successful if it stays at the institutional level. Information campaigns in local news media will probably help to reach a larger audience on the advantages and dangers of embracing cyberspace. With regard to national security, cyberspace is a genuine means of intelligence collection. The multiple examples of sophisticated computer agents that gather information in the world on potential or real enemies prove this point.⁹³ The States of the ECCAS must take advantage of the potential of intelligence gathering that sometimes does not require huge investment and is less lethal.⁹⁴ Overall, regarding informational power, the state can have a feeding or collection role in cyberspace. Where traditional means of communication are rare due to cost, in a context where the targeted audience—the young—are online; where political activists are spreading altered news in cyberspace; and where context-sensitive information on geostrategic adversaries can be found online at low cost, the states of the ECCAS region are called to exercise an informational strategy in cyberspace.

3. Economic and Social

With regard to the economic and social consequences that cyberspace activities have on a country, governments are *de facto* called to play a role. The cyber economy encompasses all ICT business conducted, including calling in a private telephone booth, building infrastructures services, and producing software, electronic commerce, and web services.⁹⁵ Although not very prominent or fully operational, this cyber economy is developing in Central Africa, typically in the form of small and medium enterprises (SME). The lack of a widely develop and decentralize banking system that reaches rural areas favors the rise of money transfer using mobile technologies.

⁹³ John Naughton, “How Flame virus has changed everything for online security firms,” *The Guardian*, June 16, 2012, accessed August 24, 2012, <http://www.guardian.co.uk/technology/2012/jun/17/flame-virus-online-security>.

⁹⁴ David Tucker, “Intelligence in the Information Age,” (lecture Naval Postgraduate School, Monterey, CA, May, 2012).

⁹⁵ Chitu Okoli and Victor Mbarika, “A framework for assessing e-commerce in sub-Saharan Africa,” *Journal of Global Information Technology Management* 6:3, 44–66, 2003, accessed August 24, 2012, <http://chitu.okoli.org/images/stories/bios/pro/research/ictdev/OkoliMbarika2003JGITM.pdf>, 7.

Indeed, IT is a very dynamic sector in Central Africa; in some countries of the region, business in the IT sector accounts for 15% of country revenues. But much more incomes are yet to be made. That is where the state's role can be critical. Along with adequate regulations and laws to promote the free market, a state can stimulate the cyber economy by supporting the creation of e-enterprises through specific programs.⁹⁶

By becoming a hub of cyber economics, the ECCAS can hold a dominant position in Africa, to the level of dictating policy to neighboring regions. And conversely, ECCAS is bordered by countries like Nigeria, Kenya, Rwanda, and Sudan, where the cyber economy is flourishing. If these countries take the lead in the cyber sector, this will create a dependency upon them which is not strategically positive for the ECCAS. The ability of the ECCAS to be autonomous in terms of ICT products and to generate revenues from cyberspace will give the region an economic independence that is not negligible in a strategic assessment of power.

In conclusion, although it is not yet clear what the impact of cyberspace has on society nowadays, the world population is increasingly connecting online for multiple reasons.⁹⁷ The digital world eases people's effort to access desired information and resources. Additionally, a society that has satisfactory services from its rulers, or even better, information about what is going on in their country, will tend to not oppose, or to complain less. In this respect, governments have justification to promote and develop cyberspace. In the case of Central Africa, this perception seems also to be true. Indeed, with the proliferation of mobile communications, people have been moving less,

⁹⁶ Brahim Sanou, "The Role of ICT in Advancing Growth in Least Developed Countries: Trends, Challenges and Opportunities," *ITU- Telecommunication Development Bureau*, 2011, accessed August 23, 2012, <http://www.itu.int/pub/D-LDC-ICTLDC.2011>, 14-16.

⁹⁷ "Internet Users In the World and Penetration Rate for 2011," *Internet World Statistics*, July 29, 2012, accessed August 24, 2012, <http://www.internetworldstats.com/stats2.htm>.

especially where roads are very bad in rural areas.⁹⁸ Many will resort to a mobile call rather than endure five hours on a two-kilometer road, or use a mobile money transfer to satisfy a parent in a remote area where there are no banks. In the last decade, the practice of mobile SMS exchange has almost changed the mode of social mobilization and news propagation. For alternative sources of information, people resort to online news, to the detriment of satellite services, which are very expensive. Many non-governmental organizations now use cyberspace to promote their agenda, thanks to wireless technologies that bypasses limitations from absence of landlines. This growing change that is happening in Central African society through ICT and cyberspace in general begs for government attention, not necessarily for control and regulation, but as a mean by which the government can improve the quality of life of its people.

4. Military

In the physical realm, the military and, in a broader sense, the security apparatus, has always been among the principal assets that guarantee the existence of states. In Africa, they are considered to be the cradle of peace and development.⁹⁹ The security forces provide protection to government institutions and enforcement and dissuasive arms for the respect of laws. They also provide for the protection of national integrity from inside and outside threats. In some countries of the ECCAS region, they even provide direct contribution to social and economic development.¹⁰⁰ For all these reasons, the role of the security apparatus in the physical realm is obvious, but in the cyber realm, the reality of this role is still undefined. Despite the use of military and other security forces to protect critical communication infrastructures, based on their recognition as national-security assets, and despite the participation of the military in frequency-management

⁹⁸ Jack Ewing, "Upwardly Mobile In Africa," *Bloomberg Businessweek Magazine*, September 23, 2007, accessed August 24, 2012, <http://www.businessweek.com/stories/2007-09-23/upwardly-mobile-in-africa>, 1.

⁹⁹ "Le Congo a célébré le 51e anniversaire de la création de ses forces armées," *Afriquinfos*, June 23, 2012, accessed August 24, 2012, <http://www.afriquinfos.com/articles/2012/6/23/congo-celebre-anniversaire-creation-forces-armees-204873.asp>.

¹⁰⁰ Shey Peter Mabu, "Forces armées: A l'image et au service de la nation," *CameroonTribune*, May 18, 2012, accessed August 24, 2012, http://www.cameroon-tribune.cm/index.php?option=com_content&view=article&id=64762%3Aforces-armees-a-limage-et-au-service-de-la-nation&catid=3%3Adossier-de-la-redaction&Itemid=57.

boards, the relation of the military to cyberspace is tiny. In fact, the military in Central Africa are merely ICT consumers; they use it as performance enhancers. But the actual role of the security apparatus can be more important. Indeed, in the developing context of cyberspace in the ECCAS region, the roadmaps ahead of the states are very dense.¹⁰¹ Priorities are multiple and cover infrastructure, education, laws, business, and security—this latter being withheld for the final stage,¹⁰² leaving the newly created cyberspace vulnerable to diverse forms of dangers. Up front, in parallel with all other efforts, the security apparatus has to take the lead and bring their experience with crime and instability in the physical world into the nascent cyber realm, making sure that networks, information systems, and laws will not have to be rebuilt because down the road they fail to meet security requirements. The experience of the military regarding secrets protection can be necessary to help identify or define priorities on what to protect immediately when moving to online capabilities. An immediate sector that the military can take advantage of is intelligence collection through the numerous collection tools available online.¹⁰³

From another perspective, the military, although not connected to cyberspace, is immersed in ICT that is embedded in various weapon systems. In a context where countries lack expertise in security matters in cyberspace, it can be economically effective to employ the military potential, which is easy to adapt and disciplined, to protect and design countermeasures against cyber criminals. In a more statutory sense, the police and national gendarmerie, which enforce law and order in the physical realm, should do the same in the cyber realm, as they are the ones with whom citizen complaints are filed. The security apparatus is a government's means for exercising authority. If these governments want to exercise that authority in cyberspace, the security apparatus

¹⁰¹ République du Congo (CG), “Stratégie Nationale pour le Développement des Technologies de l'information et de la Communication (TIC) en République du Congo,” *Ministère des Postes et Télécommunications*, December 2004, accessed July 25, 2012, www.observatoiretic.org/documents/download.

¹⁰² Republic of Cameroon, “Télécommunications et TIC: Bilan du septennat des grandes ambitions.”

¹⁰³ “Cyber Security Tools list 2012,” *Cyber War Zone*, March 13, 2012, accessed August 24, 2012, <http://www.cyberwarzone.com/cyberwarfare/cyber-security-tools-list-2012>.

has to be present also in the cyber realm. This presence means possessing the forensic and active and defensive capabilities necessary to give power to the state.¹⁰⁴

D. AREAS OF MEASUREMENT OF THE EFFECT OF STATE ELEMENTS OF POWER ON CYBER SPACE

The active role of governments in cyberspace can be measured by the observation of specific indicators in the sectors of infrastructure, information systems, legal systems, and business.¹⁰⁵

In the case of information infrastructure, the action or presence of states in cyberspace can be assessed through its investment in critical infrastructures like optical fiber networks, Internet eXchange point, server farms, power generation, and distribution. Along with these infrastructures, which one may qualify as heavy and core blocks, there are those that contribute to the coordination and control of cyberspace; these are authoritative and administrative boards that provide the necessary interface for management, operations, and interaction with cyberspace actors. The structural role of the state can also be measured by assessing the development of educational and research capabilities, which contributes to the training and awareness requirements of the population.

The other sector of concern for states is information systems. Indeed, for infrastructures to be profitable, states need to run multiple services organized in terms of information systems. Some of the root services that give cyberspace its full capabilities are so sensitive that they have to be run by the state as a matter of national security or sovereignty. These are certification authorities, national databases, interoperability and interconnection services, and some virtual environments.

With respect to laws and regulations, the state's role in cyberspace can be measured by the effective production of a national grand strategy for cyberspace,

¹⁰⁴ Akuta et al., "Combating Cyber Crime in Sub-Sahara Africa; A Discourse on Law, Policy and Practice," 135.

¹⁰⁵ Kristina Cole, et al., "Cybersecurity in Africa: An Assessment," *Sam Nunn School of International Affairs, Georgia Institute of Technology Atlanta*, April 25, 2008, accessed April 06, 2012, <http://www.cistp.gatech.edu/publications/files/AnAssessmentofAfricanCybersecurity.pdf>, 10.

adequate laws, national policies, and governmental directives, and the establishment of mechanisms for continuous screening of the legal framework for holes and inconsistencies, so that corrections can be made. In the absence of the means to produce infrastructures or information systems, states have to define well-suited laws that protect the country and its citizen from any form of alien hegemony. On this subject, one other indicator of the state presence is ability to enforce laws and regulations. This happens through the empowerment of competent structures on the matter: the police, military, and ad hoc boards.

In the business and industrial sectors, governments can be qualified based on their promotion and development of mechanism that favor business. These are, for example, taxation programs for cyber companies, supporting funds for small enterprises, and the promotion of national cyber products within the state and to foreign spheres.¹⁰⁶

E. CONCLUSION

This chapter has looked at government objectives in cyberspace in relation to the government's power instruments and the areas in cyberspace where actions are needed, postulating how those actions can be taken. Although this model is not perfect, it can help decision makers in Central Africa, and particularly in the military, have a better picture of the challenges that cyberspace presents.

In summary, although cyberspace is essentially immaterial, a government presence and authority is needed within it for various reasons. Indeed, cyberspace provides opportunities for multiple forms of actors to coexist and sometimes even to challenge the natural order of powers well established in the physical world. In the physical world, resources are static and located in specific geographical places and are subject to regulations based on territories; in cyberspace, these notions are more elusive. Cyberspace gives more margin of maneuver to entities like non-state actors, especially criminal groups that can now wage war against a state without having to cross borders or

¹⁰⁶ Magnus Linden, "The Role of Institutions and ICT Entrepreneurship in Developing Countries - The case of Cameroon," master's thesis INDEK 2011:16 at KTH the *Royal Institute of Technology Stockholm*, Sweden, 2011.

be located where they can be retaliated against.¹⁰⁷ Single individuals can now access resources previously unreachable by the lack of interconnection or absence of digital versions. For these reasons, one can say that cyberspace has undermined the power of states in favor of newly empowered actors.¹⁰⁸ But on the other hand, states have plenty to gain from being present in cyberspace, even if they are merely pushed by fate due to the technological evolution of the world. The economic benefits, the political fallout, or the benefit added to the quality of life for the population outweigh the backlash that may come from the diffusion of power.

¹⁰⁷ Kuehl, "From Cyberspace to Cyberpower: Defining the Problem."

¹⁰⁸ Joseph S. Nye, *Cyber Power*, Harvard, Belfer Center, 2010, 45.

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V. MILITARY AND TECHNOLOGY

A. INTRODUCTION

Central Africa has been continuously torn by armed conflicts, be it within individual countries in the form of civil war, political unrest, and military coups, or transnational, from rebel groups and separatist movements. Armies of the Central African region have generally dealt with their conflicts at the local level (internally), but in some exceptional cases, have put together a multinational force to cope with the problem.

All these security issues arise in an extremely complex geographical environment that is continuously changing, from desert and savanna in the north (Chad and the north of Cameroon), equatorial forest in the center, northwest, and south (the Democratic Republic of the Congo (DRC), Central African Republic (CAR), Republic of the Congo, Gabon, and Cameroon), to swamp and ocean in the southwest (Cameroon, Equatorial Guinea, and Gabon). The Central African region is also endowed with considerable natural resources of all kinds—oil, diamond, gold, copper, and timber being the most valuable—giving them powerful means for fundraising during crises. Despite this potential wealth, the region remains extremely poor and accounts for most of the bottom-listed countries in the United Nations human-development index.¹⁰⁹

This complex geographical and socioeconomic situation has impelled the militaries in the Central African region to adjust their force structures and equipment in order to succeed in their mission. In most of the cases, this would have not been possible without the help of technology. Extremely advanced technology is central to some units, like the “Batallion d’Intervention Rapide (BIR),”¹¹⁰ the special-forces unit of the Cameroonian defense forces, while other units are still far behind, such as the Central African Republic defense forces.

¹⁰⁹ “Regional and National Trends in the Human Development Index 1980-2011,” *UNDP Report*, 2011, accessed August 4, 2012, <http://hdr.undp.org/en/data/trends/>.

¹¹⁰ Joseph Roland Djotie, “Demystifying The Rapid Intervention Batallion (B.I.R),” *The Sun*, October 13, 2008, accessed August 4, 2012, http://the-news-from-cameroon.com/article.php?category_id=41&article_id=1009.

The purpose of this chapter is to try to understand how technology affects the military in Central Africa. The chapter will try to expand from that point to look at potential roles of the military in the sphere of security issues and nation-building roles, at a local and regional scope, in support of civilian efforts. Indeed, in African history, the military have generally been involved in national affairs, due to having seized political power or as a way of citizen contribution to a resourceful organization in peacetime.

In Central Africa, as in many parts of Africa, the armies are the remnants of old colonial forces left by foreign powers in the aftermath of national independence achieved in the sixties. Fifty years later, these armies have evolved slowly but steadily and in quite similar patterns. Countries with relative peace tend to have armies that are more organized, well educated, better trained, but not very experienced as far as combat is concerned; on the other hand, countries engaged in active conflicts or regular instability are less organized and educated, but possess long experience in combat exposure. Due to limited resources, the internal structures of all these armies are usually unbalanced, with, on one side, elite forces, well trained and equipped, and on the other the conventional forces, having fewer resources, aging personnel, and dysfunction within the organization.

B. FRONTS OF TECHNOLOGY PENETRATION

Within the general context describe above, one can identify two fronts of technological penetration into military organizations in Central Africa: through the acquisition of weapons systems and through administrative and headquarters need of performance enhancers. In this respect, the different military branches—army, air force, navy, and other specific branches—are penetrated by technology due to mission requirements. In Chad, North Cameroon, and the CAR for example, a specific type of light 4x4 Toyota-pickup-like vehicle has proven to be the best vector for troop transportation and deployment. These vehicles also fit the need to cover large areas with a short intervention time and small teams of four to six soldiers. Initially designed and introduced in the region for the commercial purpose of goods transportation across the desert, the vehicle caught the attention of the military for its performance and cost. The

use of Global Positioning System (GPS) devices became necessary when these armies were confronted with vehicle losses as they traveled further in the desert and unmapped areas.

As in many other cases, operational requirements provide the leading principle guiding the acquisition of new technologies such as communications, command and control, surveillance, offensive systems, and defensive systems. This mode of technological evolution in militaries capabilities generally comes with various forms of knowledge transfer. Usually, countries at war or with urgent needs are not prepared to master the knowledge behind weapon system and rely on third party (local or foreign contractor) for maintenance. All that is needed is the minimum knowledge required for the system to operate. Conversely, those countries in relative stability have more time to learn and master the basics of weapon systems they acquire, including first-and second-level maintenance, providing personnel with expertise rare in the subregion and profitable for the nation in other economic sectors.

From a more tactical military operations standpoint, the possession of an innovative weapon system has proven crucial to the issue of conflict in the subregion. The side with efficient and cheaper weaponry is likely to sustain its campaign and impose a stalemate on its adversary, forcing him to the negotiation table or to retreat and accept defeat. This was the case in Chad in February 2008, when the forces loyal to the government repelled a rebel assault on the capital city with the support of two helicopters and air-surveillance information.¹¹¹ This was also the case in Cameroon in 1994, when an outnumbered unit of Cameroonian forces was able to stop the advance of Nigerian forces on the Bakassi Peninsula with high-precision artillery fire, imposing a stalemate in a conflict that was finally arbitrated by the International Court of Justice.¹¹²

¹¹¹ "Battle of N'Djamena (2008)," *Wikipedia*, September 9, 2011, accessed August 5, 2012, http://en.wikipedia.org/wiki/Battle_of_N%27Djamena_%282008%29.

¹¹² Ntemfac AN Nchwete Ofegbe, "Oil Politics Around the Bakassi Peninsula," *PostWatch Magazine*, May 22, 2005, accessed August 5, 2012, http://www.postwatchmagazine.com/files/bakassi_petroleum_politics.pdf, 4.

Technology, through new weapon systems, enhances logistics and telecommunications systems, and plays the role of force multiplier, providing the state, which is generally in a disadvantaged position, the superiority needed to overcome its foes.

On another front, technology in Central Africa penetrates militaries through their administrations and headquarters. Indeed, in all these decision places, there is the progressive use of information technology to help improve the situational awareness of forces, gather intelligence, and improve the managerial system of human and logistic resources. Opinions have progressively shifted from seeing computer systems as sources of leaks in an organization ill of secrecy, to sources of efficiency in dealing with huge amounts of data (personnel, money, and material). The urgent desire for results has simply surpassed the apprehension about technological weakness.

The national gendarmerie, a paramilitary police corps inherited from the French colonists and spread through all the countries of the Central African region, provides a police function for the rural and border population, and also in urban centers, acting jointly with regular police forces. They have been continuously submitted to security challenges of various natures. The introduction of information technology in their daily tasks is considered one of their major evolutions in the past decade, providing them with the ability to improve emergency response and quality of service. Again on this front, but not as much as for weapons systems, technology is not acquired with the knowhow that goes with it. Central African militaries are more often end users of commercial, off-the-shelf (COTS) equipment than of professional and purposely designed devices—at least in the early stages.

Although information technologies are used to foster good performance in administrations, the whole system remains driven by old concepts and doctrine. There is not yet a reliance on technological assets to determine the way ahead. The impact of technology on military affairs in Central Africa is more likely to be considered indirect, supportive instead of driving. Indeed, none of the military in the region can claim to have a superior basis of technological potential. Nonetheless, decision makers are now relying on new technologies to provide specific solutions in the geographical and economic

environment. For example, the BIR special forces in Cameroon have come to use technology like broadband wireless communication to operate in the southwest, where there was no other available affordable solution. The service was put in place in the form of a private business company offering information technology services to a population in a remote and enclosed area, with Special Forces the first and major client.

C. SOURCES OF TECHNOLOGICAL INNOVATION

In the movement toward innovative ideas and solutions to fit the local environment, two models for introducing new ideas have generally prevailed: the insider and the externally influenced models. The introduction of new ideas, when they come from inside the military, are often initiated by young officers trained abroad and freshly incorporated in their unit. They generally tend to introduce innovative solutions at the granular level in a bottom-up approach. For instance, topics like access to the Internet and local distribution of Internet services in their office and unit are ideas that spread among a network of friends. Other ideas, like the use of personal GPS in remote areas and of personal computers to organize daily tasks or to enhance group presentations finally end up defining the new mode of working as they are adopted by others in the chain of command. This type of approach has the advantage of being more attractive and trusted by the innovator's peers. The most organized and systematic insider model comes from the foreign-military advisory system, the famous "Assistance Militaire Technique." These are military personnel of foreign powers embedded in local armies at all levels. They provide the locals with advice on the best ways to solve a given problem and simultaneously, through special funding from their governments, acquire and introduce technological solutions and training. Despite the limited budget available to these advisers, they are genuine conduits of technological change in African militaries.

Technology also flows through the military organization via external agents. These are local or foreign private companies that are conscious of the multiple needs and challenges faced by African security apparatus and come out with customized solutions for the local environment. Key selling points are generally the environment and price. The services offered covers multiple domains with the most important being software

engineering, communications systems, surveillance, and weapons systems. Since the private operators are primarily business peoples, with a principal objective of making money, they do not always offer business models that fit the available budget or the commander's mission priorities. Indeed, their conception of military operations is hampered by lack of experience in African military affairs.

Beside the three informal vectors for introduction of technology presented above, there are also formal procedures. These are built-in organizational structures in the military that are in charge of permanent observation and scrutiny of the global market for new process and solutions. Without research and development structures, these departments are often involved in military cooperation with foreign powers in search of new or refurbished equipment, new technology, and training at all levels for military personnel.

D. TECHNOLOGY AND MILITARY DOCTRINE

For all these modes of innovation, the main concept is adaptability. Indeed, technology is often introduced to try to adapt to an existing operational context. To our knowledge, there has not been a single case in the region where technology was the leading concept. None of the military strategies was built on a specific capability offered by new technology. In this respect, one can say that technology in Central Africa fits the doctrine of use of forces or combat and never the inverse. Nevertheless, at the tactical level, the possession of equipment of high reliability and performance contributes to optimizing a commander's confidence in his strategies. Moreover, the introduction of innovative solutions usually leads to changes in tactics on the field, rendering military units more zealous and willing to take more risk because of their feeling of superiority.

The driving factors of innovation introduced in the military are generally major events in the tactical arena that bring social, emotional, or political consequences. One can cite rebel breakthroughs with sounding actions (Chad, the Republic of the Congo, the CAR, Cameroon), badly managed social unrest (Cameroon, Gabon), increasing transnational criminal activities (Equatorial Guinea, Cameroon, the CAR, Chad, the DRC), and noncompliance with international agreements (e.g., changes in standards,

participation in foreign military operations). After disastrous events that undermine the national image, political leaders and commanders look for new solutions to prevent a repetition, and thus are more inclined to listen to innovative answers suggested by private and well-connected contractors, young officers, or foreign military advisers. For these innovations to happen generally takes many years, for several reasons. There is the resistance of the old generation, the “vieille garde.” Despite the usefulness of all the solutions proposed which are sometimes proof-ready, conflict of generations, ignorance because of lack of education, the risk of losing one’s influential position in the system, corruption and personal interest, many of the old line oppose the implementation of new ideas. Beside these human factors, the economic climate also hinders the advancement or sustainment of newly introduced innovation. Indeed, most of these changes come with an increase in organizational spending that, at least in the starting phase, are not welcomed by decision makers. This is where political leadership matters. The personal qualities and receptivity of leaders at the head of the Defense Department and Commanders in Chief are often very important in weighting the balance of innovation. This influence can be illustrated with the case of the Republic of Gabon, where, under the leadership of the Defense Minister—the son of the former head of state and a fan of technology—the country made a tremendous breakthrough in their military medical capabilities, which has become one of the most advanced in the subregion.¹¹³ Or the case of Cameroon, where the commitment of the commander in chief gave the opportunity to generate a Special Forces unit—the BIR—endowed with advanced and sophisticated capabilities.¹¹⁴

In spite of that leadership which favors the development of technology, the military in Central Africa have not been able to mandate some specific technologies in their units. The tendency remains to adapt available solutions to needs in a cost–benefit calculus. One can cite the use of virtual private networks to transit information through open computer networks, the customizing of commercial helicopters for combat missions

¹¹³ “Gabon : Libreville aura son école de santé militaire,” *Gabon Eco*, October 10, 2008, accessed August 5, 2012, <http://www.bdp-gabon.org/articles/2008/10/10/gabon-libreville-aura-son-ecole-de-sante-militaire/>.

¹¹⁴ Joseph Roland Djotie, “Demystifying The Rapid Intervention Battalion (B.I.R),” *The Sun*, October 13, 2008, accessed August 4, 2012, http://the-news-from-cameroon.com/article.php?category_id=41&article_id=1009.

and military exhibitions during national events, and the use of COTS 3G/4G devices in the absence of access to professional communication systems, which are expensive.

As soon as a technology is fully adopted by the military, it becomes a pseudo-standard, integrated in the doctrine of force use. The military apparatus then uses its workforce, training facilities, capabilities, and discipline to develop expertise that is sometimes not available within the region's civilian realm. Unless they are involved in peacekeeping operations or internal conflict, this potential remains dormant. But there are some exceptions: military capabilities in domains like civil engineering and logistic chains have often been used by the states to fill gaps in operational capabilities. In Cameroon, as in Gabon, for example, the military engineer corps is deeply involved in nation building, from roads and schools to government-building construction in remote areas. In the telecommunications realm, the military in the Congo (Brazzaville), Gabon, and, to a certain extent in Cameroon, play an important role in regulation and infrastructure deployment.

E. CONCLUSION

In conclusion, as far as technology is concerned, military organizations in Central Africa exist in a global sociopolitical and economic context where they are very important actors. Thus, they are affected by the technological breakthroughs that might be suitable for the region. But like all armies, they experience many difficulties in the assimilation (or innovation) process. Overall, the militaries in Central African deal with technology in a submissive way, rather than being leading actors. Nevertheless, as soon as a technology is incorporated, they usually are quick to master it and excel in its utilization. These acquired abilities are generally not used to their full potential. Some military corps of the region, such as the engineer and signal corps, put their expertise to the service of nation building and can be used as models for the whole military organization to help develop a subregion that is striving to get out of its socioeconomic stagnation. One of the sectors where this contribution will certainly be welcome is information technology and cyberspace, where the security aspects are not yet implemented.

VI. GENERAL CONCLUSION

The Economic Community of Central African States is an organization that already exists and possesses functioning organic structures.¹¹⁵ In a context where actionable resources are rare and scattered across the community, and because the cyber realm is said to be without borders,¹¹⁶ one can hypothesize that collaboration built upon existing assets that promotes the sharing of cyber resources and capabilities within the region would be a good point of beginning. Such cooperation will help to create a strong cyber environment conducive of the confidence and trust necessary to tip off a “Cyber Community of Central African States” (C3AS).

A. THE CYBER COMMUNITY OF CENTRAL AFRICAN STATES (C3AS)

One fundamental truth of cyberspace is that it is universally accessible—thus the idea of a borderless realm. This concept brings up the need to cooperate as the first variable of success especially in Central Africa where no country pretends to have all the resources or capabilities required to prevail. Given the fact that when a cyber resource is available online it can be useful to all in the region, and having an existing community of states where the pillars of regional cooperation are established, the countries of ECCAS should put together their resources in a mutual agreement and create a formal “Cyber Community of Central African States” (C3AS). Such a cyber community will strengthen the basis for Central African cyberspace and make it better prepared to face the challenges that come with it. Overall, countries in the region face the same sort of problems: poor infrastructures, education, and regulations.

At the infrastructural level, interconnecting all regional networks will bring multiple advantages. First, those countries without access to undersea cables for high-

¹¹⁵ ECCAS is a political and economic organization of Central African states that comprises Cameroon, Central Republic of Africa, Chad, Democratic Republic of Congo, Equatorial Guinea, Gabon, Republic of Congo, and Sao Tome and Principe. See “Communauté Economique des Etats de l’Afrique Centrale,” *CEEAC-ECCAS*, accessed August 23, 2012, <http://www.ceeac-eccas.org/>.

¹¹⁶ Daniel T. Kuehl, “From Cyberspace to Cyberpower: Defining the Problem,” in Franklin D. Kramer, Stuart Starr, and Larry K. Wentz, eds., *Cyberpower and National Security* (Washington, D.C.: National Defense UP, 2009), 24.

speed access to the Internet will be connected through their neighbors.¹¹⁷ Second, an interconnection through high-speed links will make it possible for countries of the region that possess core ICT infrastructures like IXP, PKI, or server farms to share with the others services that for now are only available from another continent.¹¹⁸ It will be even possible to create redundancy infrastructures to deal with eventual failure. Interconnection will also bring access to knowledge by linking regional universities or training centers.¹¹⁹ With regard to security, a mesh grid of interconnected networks of ECCAS countries will reduce the likeliness of a state's being isolated from cyberspace due to a disagreement with neighbors who were network-access providers. The Central African backbone (CAB) project, which is now finishing the interconnection of three states of the subregion (Cameroon, Chad, and the Central Republic of Africa), and in its latter phase will interconnect the rest of the countries of the region while providing core-infrastructure facilities like IXP, PKI, and server farms, constitute a sample of the model envisioned in the C3AS concept and is to be encourage. Other projects of this nature have to be developed to create a solid core for the C3AS. In that manner, as for the energy sector, the Central African region (Democratic Republic of Congo, Cameroon, and Gabon) disposes of a tremendous energy potential that can be developed and shared through an interconnected energy grid. This gives the region an opportunity to solve its energy gap, a good thing for ICT development.

At the information-systems level, virtual environments and delocalization of resources are technologies that have been proven robust against attacks aimed at one geographically located information system.¹²⁰ Therefore, through a collaborative endeavor, countries in Central African could develop multiple data-center

¹¹⁷ Rebecca Mayer et al., "Costing the Needs for Investment in ICT Infrastructure in Africa," *World Bank-AICD*, January 2008, accessed August 25, 2012, <http://www.eu-africa-infrastructure-tf.net/attachments/library/aicd-background-paper-3-ict-invst-summary-en.pdf>, 7-8.

¹¹⁸ Christopher Jator, "Central Africa: CemaC Countries Embrace High-speed It Development," *Cameroon Tribune*, 14 June 2012, accessed August 25, 2012, <http://allafrica.com/stories/201206141160.html>.

¹¹⁹ Christopher Jator, "Cameroon: CEMAC Universities Embrace Modern Technology," *Cameroon Tribune*, July 29, 2010, accessed August 25, 2012, <http://allafrica.com/stories/201007290850.html>.

¹²⁰ John Arquilla, "From Blitzkrieg to Bitskrieg: The Military Encounter with Computers," *Communication of the ACM* 54, n°10, 2011:58-64, accessed August 25, 2012, <http://dl.acm.org/citation.cfm?id=2001287&dl=ACM&coll=DL&CFID=108163223&CFTOKEN=51245222>.

environments—a subregional computer cloud—which if interconnected can help to build cheaper distributed information systems that are robust and resilient to the benefit of all its members. Such a regional computer cloud will present tremendous economic advantages, as it will help reduce the amount of traffic out of the C3AS sphere, thus having an impact on the contractual bandwidth for external transaction.¹²¹

A Central African cyber community will only be possible if there is a common desire to make it happen. This is to say, diplomatic efforts have to be paramount. Indeed, the decision makers of the ECCAS region have to come together and put in place a global strategic plan that will set the path to a C3AS. The framework of the economic community (ECCAS) constitutes a background that only needs to be reinforced and strategized. In that respect, there are many contacts that exist between the different administrations in charge of ICT, but these exchanges remain just a forum for discussion and opportunities, not a community where members see themselves as engaged in the same struggle.¹²² This forum of exchanges between ICT leaders has to evolve into a decisional structure in charge of all the ICT strategies of the subregion, defining directives, regulations, and laws to be enacted by the parliaments. In that sense, all the countries of the subregion must harmonize their legal framework on ICT and have a comprehensive strategy of development. The less advanced will benefit from the achievements of the other members and the most advanced will benefit from the elimination of unstable areas within their vicinity.

As noted earlier, education constitutes one of the strongest pieces of ICT development; in the ECCAS region, the countries are not at the same level in that matter. A collaborative initiative will facilitate access to training infrastructures to all members at a relatively low cost.¹²³ The few available universities' becoming centers of excellence

¹²¹ Dias Nyesiga, "Cloud Computing to Cut Business Cost," *The Sunday Times*, June 4, 2012, accessed August 25, 2012, <http://www.newtimes.co.rw/news/index.php?i=&a=10714&week=23>.

¹²² Lukong Pius Nyuyilime, "Central Africa : Telecom experts want phone rates reduced," *CIPACO*, June 3, 2006, accessed August 25, 2012, <http://www.cipaco.org/spip.php?article651>.

¹²³ Emmanuel Tonye, "La formation continue et à distance (FOCAD) en Afrique centrale : étude de faisabilité contextualisée," *AUF-RES@TICE Report*, May 2008, accessed August 25, 2012, <http://www.resatice.org/IMG/pdf/tonye.pdf>, 11–12.

for regional training and research for the promotion of ICT may help create adequate training programs and technological solutions for the local needs of the population.¹²⁴

Another aspect that is crucial in this collaborative initiative is law enforcement. The growing trend of cyberspace crime, which for now revolves around scams and identity theft, calls for an intensive collaboration between law-enforcement agencies (exchange of information, continuation of investigation, training, and expertise sharing).¹²⁵

B. DEVELOPMENT OF TRUST IN THE C3AS

The potential gain from a cyber community in Central Africa is significant. Indeed, when one considers that the region possesses a population of nearly 114 million inhabitants, mostly youth—who are grand consumers of ICT—developing a robust, resilient, and secure cyber environment can generate revenues for the states and economic gain for the population, not to mention the quality of life that comes as a bonus. The reluctance of foreign companies to sell or provide some category of service in Central Africa is a sign of mistrust. That is also true when it comes to electronic transactions, even within the region, where a lack of visibility on the means of recourses that consumers may have deters them from risking their money in cyberspace. The concept of a mutualization of resources—human, intellectual, infrastructural, political, and economic—in a common goal will create an environment conducive of trust. Generating confidence in cyberspace by promoting trust will fade away the various potential risks that exist in the C3AS, leaving a brighter future.

When it comes to social behavior, there are several criteria that presumably can help build trust and therefore contribute to shaping the behavior of a population. In the case of cyberspace, things are not so different; potential actors in cyberspace (or consumers of cyber products) will also be sensitive to these elements of trust. As presented by Piotr Sztompka P in his book *Trust*,¹²⁶ the first element of trust one can

¹²⁴ Tonye, “La formation continue et à distance (FOCAD) en Afrique centrale ...,” 15.

¹²⁵ Cole et al., “Cybersecurity in Africa: An Assessment,” 26.

¹²⁶ Sztompka Piotr, *Trust: A Social Theory*, New York, NY, Cambridge University Press:1999, 69.

think about is *normative coherence*; to the extent that people share the same values (morality, integrity, benevolence, skills level, and etc.), and have the same expectations, trust will be easier to build. In the case of ECCAS, this is quite true; people in the region share similar ethnocultural values, economic conditions, and the levels of technology. It will be much easier for people in Gabon to understand what are the needs and expectations of their neighbors in Cameroon, the Congo, or Equatorial Guinea, and vice-versa. As a matter of fact, normative coherence is a criterion that is naturally given to the ECCAS, thanks to the common history of the people in that region.

The second element of trust is *accountability*. Obviously, everyone that engages his money online will need to be able to follow the trail and be able to react in case of any attempt to divert it from the original aim by the recipient. On that question, services offered in cyberspace by people located in the geographical area of the ECCAS will reflect a better impression of safety to costumers within the region than if the provider is miles away. The simple fact of being located within the region becomes an advantage. Moreover, the establishment of uniform means of recourse within the C3AS will constitutes a strong step forward in accountability when there are disagreements. In a community where laws are enforced properly, those that provide services will be constrained by the reality of retaliation in case of failure to comply with contractual commitments.

An *educated* population that understands how transactions in cyberspace work will be less reluctant to use it. The knowledge of this realm thus contributes to providing the population with the necessary confidence to counterbalance skepticism.

Many cyber businesses are run by young, computer-savvy entrepreneurs in the backyard and bedrooms of private homes; bringing more *visibility* to their activities in line with who they are, how their services are provided, and with whom they are affiliated, will give assurance or setback to potential clients.

These *transparency* elements can only be provided in an environment where cyber-service providers are encouraged to step out of the darkness and make themselves known to the public. Such encouragement to go official will be promoted by a global strategy for the subregion.

The feeling of *security* also plays an important role in trust development. At the level of the state, the assurance that cyberspace will not be a source of political instability or social unrest can be a strong incentive for decision makers to consider the advantages that may exist in that realm. At the user level, the absence of negative experiences encountered by user gives them the impression of security, which overall favors confidence in cyberspace use. At a regional level, a fully meshed network grid contributes to reducing the risk of network disruption against one of the member states, providing each state with the perception of security, a perspective that urges each to adhere to the interconnection concept.

In conclusion, a C3AS environment that is trusted because of the existence of normative coherence, accountability, transparency, and security will be a perfect recipe for tipping the expansion of cyberspace in the subregion. This will permit foreign investors to provide the necessary momentum for this realm to become a true instrument for development and peace by fighting poverty.

C. CONCLUSION

At a moment where Central African region countries are moving towards cyberspace, with multiple efforts being done to bridge the numeric gap with the rest of the world, such as linking to high-speed broadband-transmission undersea cable and introducing information systems into the daily life of citizens in the administration and the private sector, there are many concerns regarding state control over this sprawling and boundless realm. Questions are asked about how cyberspace can change the daily life of Central African citizens, how the states can benefit, and what the risks of embracing the new reality are. Because of the socioeconomic context of the ECCAS region and the political reality in many of its countries, the approaches to cyberspace are diverse, from indifference to pseudo grand strategy. These different approaches expose the region to

the numerous risks that come with cyberspace and hinder the advantages that states could derive from it. For the states of the Central African region to find their way out of a time of much tragedy and enjoy the benefit of the power of cyberspace, they need to put their assets in common to form a “Cyber Community of Central African States” that will give them a strong basis from which to withstand the beast.

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APPENDIX A. THE REPUBLIC OF CAMEROON

With a population of nearly twenty million inhabitants in 2012, the Republic of Cameroon is one of the leading countries in Central Africa in terms of economic, political, and educational factors. Despite Cameroon's economic performance within the Central African subregion, the quality of its human resources, the wide variety of its cultural assets, its infrastructural potential, its strategic position which provides access to the sea to several countries in the region, and the political stability it enjoys, the country remains one in which ICT penetration and usage are relatively low. Ranked 125 over 142 in the Networked Readiness Index (2.9/7) by the 2012 "Global Information Technology Report" of the World Economic Forum,¹²⁷ Cameroon shows a burgeoning activity in the information technology area.

According to the findings of a national survey (Scan ICT) conducted in 2006 by the Ministry of Posts and Telecommunications (and updated in 2012), with support from development partners, telephony services were available in only 50.55% of the country, with a fixed teledensity of 3% and mobile teledensity of 90% in 2012. The survey also showed that less than 7% of institutions and enterprises were equipped with a computer, less than 27% of government services were connected to the Internet, and around 5% of Cameroon's population uses the Internet. The data in Table 1 describes below, provides a brief overview of the socioeconomic indicators pertaining to the country.

¹²⁷ Soumitra Dutta and Beñat Bilbao-Osorio, "The Global Information Technology Report 2012: Living in a Hyperconnected World," *World Economic Forum*, accessed June 10, 2012, http://www3.weforum.org/docs/Global_IT_Report_2012.pdf, 197.

Table 1. Socioeconomic Indicators: Cameroon

N°	Indicator	Value
1-	Area	475,440 sq km
2-	GDP	\$47.12 billion (2011 est.)
3-	Official languages	French (71%) and English (29%)
4-	Total population	20,129,878 (July 2012 est.)
5-	Population rate between 0-14 years	40.5% (male 4,027,381/female 3,956,219)
6-	Youths (under 25, of which 47% are between 5 and 24)	63%
7-	Life expectancy	54.71 years
8-	Urbanized population	58% of total population (2010)
9-	Average annual growth rate of urban population	3.3% annual rate of change (2010-15 est.)
10-	Per capita gross national income (US dollars) GNI	\$ 2 284
11-	Population below \$1 a day	33.4 %

A. INFRASTRUCTURES

The technological landscape of Cameroon is profoundly diverse. It offers a variety of technologies for broadband data transportation to end-user distribution. The core network, which is essentially well develop in urban and rural area, comprises fixed dial-up telephone lines and HF and VHF communications for long-distance links. For many years, satellite-communications devices were the sole means to reach remote areas and connect with the external world, whether it were by phone, television, or Internet. Today, others forms of technologies have been introduce, like optical fiber for interconnection with undersea cable and very small-aperture terminals (VSAT). For urban communication, technologies like ADSL, GSM, GPRS, 3G, CDMA, WIFI, WIMAX, and optical fiber links are now common and accessible.

In Cameroon, information technologies are provided to the population through a very limited number of operators. The Societé des Télécommunications du Cameroun, alias CAMTEL, a state-owned company, is the sole provider of land-fixed telecommunication services. Along with two other companies, MTN Cameroon and

ORANGE Cameroon, CAMTEL provides the country with mobile (wireless) communication services with a total number of ten million¹²⁸ subscribers.

CAMTEL is also the root company in charge of the exploitation of the undersea optical-fiber cables (SAT3/WASC) that terminate in Cameroon, which make CAMTEL one of the principal distributors of Internet to the rest of the low-level services providers. Internet services are provided to the population by nearly fifty¹²⁹ operators, using a mosaic of technologies from dial-up to VSAT via wireless local loops.

In the past five years, Cameroon has been developing a program with the aim of interconnecting all the country with a network of optical fiber for a backbone of nearly 5000 Km.¹³⁰ This program, which is supposed to reach completion this year (2012) will provide a particularly high level of interconnection unique in the subregion. Additionally, with the countries of the Central African region, Cameroon has acquired a 1500 km of optical fiber to interconnect with the republics of Chad and Central Africa.¹³¹ In order to guarantee the quality of its Internet access, the country has diversify its access to broadband Internet connection by taking shares in three other undersea optical-fiber cable networks (WACS, ACE, MAIN ONE) and is participating in the regional telecommunication satellite project, RASCOM.¹³²

¹²⁸ "Informations statistiques sur le marché de la Téléphonie – Premier et Deuxième Trimestres 2011," *ART Cameroon*, September 19, 2011, accessed October 02, 2012, <http://www.art.cm:81/images/doc/aper%2B%BAu%20%2B%AEvolutif%20%20trimestriel%202011.pdf>.

¹²⁹ "Broadband Internet Service Providers (ISP) in Cameroon," *Who Is This*, accessed October 02, 2012, <http://www.whoisthisip.com/isp-ip-usage-country-Cameroon.php>.

¹³⁰ "Cable: Cameroon will interconnect the 10 regional capitals in less than one year," *Emploi Service*, August 10, 2010, accessed October 02, 2012, http://www.emploiservice.net/index.php?option=com_content&view=article&id=254&lang=en

¹³¹ "World Bank approves Central African Backbone project," *IT News Africa*, October 7, 2009, accessed October 02, 2012, <http://www.itnewsafrika.com/2009/10/world-bank-approves-central-african-backbone-project/>.

¹³² Republic of Cameroon, "Télécommunications et TIC: Bilan du septennat des grandes ambitions," *Ministry of Posts and Telecommunications*, February 2012, accessed August 2012, http://www.minpostel.gov.cm/index.php?option=com_content&view=article&id=125%3Ale-bilan-des-telecommunications-et-tic-dans-un-ouvrage&catid=50%3Aa-la-une&lang=fr.

Cameroon does not yet have an Internet Exchange Point (IXP), but according to the state agency in charge of the promotion of IT, the project is on its way. Nonetheless, there are still numerous steps to bridge for the IXP to become reality.¹³³

The root of the telecommunication infrastructure that wired Cameroon is possessed by CAMTEL, the historic operator in the country. Indeed, by the fate of history, CAMTEL has inherited the entire backbone infrastructure that meshes the country to the district level and provides the necessary relays for dial-up exchange. Most of this infrastructure remains analog, with a progressive mutation to digital. It is the rate of this mutation that conditions the spread of the Internet in rural areas.

With the outbreak of wireless technologies, GSM – 3G – 4G – and others, the major ICT actors of the country, competing for customers, are deploying, at their initiative, numerous “base stations” throughout the national territory. This new wireless movement creating a double speed for the penetration of IT in the country, making that some areas that have never seen any form of technology because of their isolation, suddenly are exposed to the latest available IT solution in the world.

The existence of server farms is very limited and essentially concentrated in the hubs of the principal ICT services providers, which are all in the two cities of Douala and Yaounde. Due to the low level of electronic commerce, in the country, data centers are yet to be implemented locally. Nevertheless, some private companies and state organizations have considerable server infrastructure to handle their data: banking, water and electricity, state human resources, and financial systems.

¹³³ World Bank, "Central African Backbone Project in Cameroon: Technical Assistance on the Preparation of a Feasibility Study for the Establishment of an Internet Exchange Point (IXP) (National/Regional)," *World Bank Project List*, July 28, 2010, accessed October 2, 2012, <http://www.devex.com/en/projects/central-african-backbone-project-in-cameroon-technical-assistance-on-the-preparation-of-a-feasibility-study-for-the-establishment-of-an-internet-exchan>.

To back up the information-technology infrastructure, Cameroon has a stable energy infrastructure. This energy infrastructure is 70% based on hydroelectric power, supplemented by thermal energy in areas not covered by the hydroelectric distribution network. Urban access to electricity is well covered, but the quality of the electricity produced needs improvement. Daily power outages remain serious issues that put cyber infrastructure at risk. In rural areas, access to electricity remains difficult. At the individual level, people resort to power generators for their personal use, exclusively reserved for nighttime. This situation contributes to delay in technological penetration. For their relays and base stations to remain operational in remote areas, ICT operators use solutions like solar-powered systems combined with thermal generators.

Cameroon has no real ICT industrial facilities as such; most of the equipment is imported, including access equipment (radio and television sets, computers, telephones) as well as routine-maintenance equipment. Thus, the country is totally dependent on imports as far as the acquisition of equipment and software for ICT development are concerned.

B. INFORMATION SYSTEMS, BUSINESS, AND INDUSTRIES

The infrastructure describe below operates with a quite diversified set of operating systems (OS). Generally, for industrial infrastructures, the operating systems are proprietary and are likely to be tied to the companies' internal policies. But at the level of the end user, the most commonly used systems are Microsoft Windows, Linux, and Macintosh. The use of Open Source OS remains much less academic than professional.

The services offered in Cameroon cyberspace gravitate around web hosting, communications (VOIP, SMS, e-fax, e-mail), and web navigation. Electronic commerce is having difficulties taking off. There are many small and medium enterprises marketing ICT products and services (although based mainly in Douala and Yaounde). Most of them are local branches of foreign firms or have concluded local representation agreements with such firms (e.g., Software solutions, Networking Solutions, RFID –

GeoTagging – GeoLocalization, and IT Security). However, the design, production, and marketing of local products and services are still rudimentary; hence Cameroon is more or less an ICT products consumer.

One sector that has significantly embraced cyber is banking. From well-established financial institutions to burgeoning micro-finance companies, they all utilize IT to proceed in their daily tasks. Where IT becomes crucial is in money transfer, using the current GSM technology well disseminated across the country; micro-finance companies have developed a prolific and competitive new way of exchanging and making money transactions.

In the public sector, a lot of effort is being done to use information technology. Three projects are being conducted: one by the state finance service, Integrated System for the Management of Public Finances (SIGEFI), another by the state human-resources service, Integrated System for the Computerized Management of State Personnel and Salaries (SIGIPES), and the last by the customs department (SYDONIA), for trans-border customs clearance and tracking of merchandise. Other projects, like the digitalized electoral list, the social security and health systems, and the e-government system are in gestation.

In prelude of the fully establishment of electronic commerce and other online transactions, the government of Cameroon in line with a law package, is acquiring a public key infrastructure (PKI). This infrastructure, which meant to be operational in 2012, will provide the necessary platform for authentication and electronic signing for all Internet users of the country and the region.¹³⁴

Although the audiovisual sector has existed a long time, the liberalization of the sector has encouraged private initiatives. For instance, private newspapers, radio, and television have small resources for production and distribution. These new media have espoused IT to boost their business and reach a broad audience, resulting in the wide spread of private media on the Internet. However, content and a program productions industry is still awaited. Generally, the low quantity and quality of national audiovisual

¹³⁴ Republic of Cameroon, “Télécommunications et TIC: Bilan du septennat des grandes ambitions.”

production does not allow Cameroon to stand as a major player in the huge global market, with far more than merely economic implications.

C. LAWS, REGULATIONS, AND ORGANIZATION

1. Strategies and Policies

At the strategic level, by inaugurating a multimedia resource center at the Lycée Général Leclerc in Yaounde in November 2001, the president of the republic defined the vision of a country “which is bracing up to adapt to the requirements of the information society.” In his address to the nation on 3 November 2004, in the wake of his election to a new seven-year term of office, he restated that “the country needs generalized Internet access.” In all respects, the context is thus favorable for strong action towards defining a bold ICT development and deployment policy and for formulating effective and coherent strategies to speed up Cameroon’s access to the global information and knowledge-based economy. “In the next 25–30 years, the target will be to move to the category of average access with a digital access index between 0.4 and 0.5. As concerns the telephone, the objective is to multiply by five the number of telephone lines and increase mobile telephone network coverage.”¹³⁵ This statement from the grand strategy document of Cameroon for the next 25 years expresses the continuity of the desire of this country to develop its ICT environment.

2. Laws and Regulations

The legal and regulatory framework for the telecommunications sector is quite developed, with laws in place addressing telecommunications regulation,¹³⁶ the establishment of Cameroon Telecommunications Corporation (CAMTEL),¹³⁷ the

¹³⁵ Republic of Cameroon, “CAMEROUN VISION 2035,” *Ministry of Economy, Planning and Regional Development*, June 2009, accessed October 2012, http://congress.cpsociety.org/wp-content/uploads/2012/04/Cameroon_VISION_2035_English_Version.pdf.

¹³⁶ Republic of Cameroon, “Law No 98/14 14 July 1998 and Law No 2005/13 29 December 2005,” *Cameroon National Assembly*.

¹³⁷ Republic of Cameroon, “Decree No 98/198,” *Presidency of the Republic of Cameroon*, September 8, 1998.

institution of minimal service in the telecommunications sector¹³⁸ and modalities for the operation of telecommunication networks¹³⁹ and provision for telecommunication services.¹⁴⁰

Recently, to deal with concerns that electronic commerce, mobile telephone services, and Internet access were not considered in previous legislation, two laws were enacted by the National Assembly. The first resolves the government need for a regulatory environment for the use of ICTs in business, the need to better protect IP and freedom of access to information, and the legal recognition of electronic signatures, EDI, and legality of contracts or transactions concluded on the web.¹⁴¹ The second law was designed to address cyber crimes and cybersecurity issues.¹⁴² This law on cyber crime, the first of its kind, set the framework and definition of cyber-crime terms and the framework of collaboration between the different national and international entities to tackle the cyber criminal. Although there is now a judicial framework for cybercrime in Cameroon, the country still needs to build infrastructure and train personnel to enforce these new laws. The national security forces are still inadequately suited for the task.

It should be acknowledged that there is no harmonized legal framework for ICT regulation at the subregional level.

3. Information Technology Administration and Management Organization, and Infrastructures

A number of institutions are involved in the control and development of ICTs in Cameroon. The government has general oversight of the development and control process, but there are also dedicated institutions.

¹³⁸ Republic of Cameroon, “Law No 2001/10,” *Cameroon National Assembly*, July 23, 2001.

¹³⁹ Republic of Cameroon, “Decree No 2001/830/PM,” *Cameroon Prime Minister Services*, September 19, 2001.

¹⁴⁰ Republic of Cameroon, “Decree No 2001/831/PM,” *Cameroon Prime Minister Services*, September 19, 2001.

¹⁴¹ Republic of Cameroon, “Law No 2010/011 and 2010/013,” *Cameroon National Assembly*, December 21, 2012.

¹⁴² Republic of Cameroon, “Law No 2010/012,” *Cameroon National Assembly*, December 21, 2012.

The presidency of the republic plays a determining role, since it defines and lays down guidelines for the national ICT policy. The authorities in Cameroon are conscious of the vital role this sector plays in economic development, good governance, and poverty reduction. The importance attached to this sector is evidenced by the fact that NAICT—the institution directly responsible for laying down guidelines and regulations for the ICT sector in Cameroon—is placed under the technical supervision of the presidency.

The prime ministers' office is responsible for monitoring, that is, ensuring that the national ICT policy is effectively implemented.

A number of ministries are involved in the deployment and exploitation of ICTs at various levels, including the ministries of communication, trade, economy, and plans and infrastructures.

Established in 2002 the NAICT (ANTIC in French) is responsible for harmonizing technical standards, providing design and development expertise to government ministries, coordinating establishment and monitoring of public-sector Internet, intranet, and extranet sites, contributing to technical training of instructors for universities, colleges, secondary, and primary schools, and training public-sector personnel.¹⁴³

The ministry of posts and telecommunications (MINPOSTEL)¹⁴⁴ is particularly responsible for formulating, implementing and evaluating government policy in the domain of posts and telecommunications. It also has supervisory authority over the telecommunications regulatory board (TRB). MINPOSTEL's duties further include contributing to the development of infrastructure and network access to new information and communication technologies.¹⁴⁵

¹⁴³ Republic of Cameroon, "Decree No 2002/92," *Presidency of the Republic of Cameroon*, April 8, 2002.

¹⁴⁴ Republic of Cameroon, "Decree No 2005/124," *Presidency of the Republic of Cameroon*, April 15, 2005.

¹⁴⁵ Republic of Cameroon, "Article 54 in Decree No 2005/124," *Presidency of the Republic of Cameroon*, April 15, 2005.

The TRB is the public institution particularly responsible for regulating, controlling, and monitoring the activities of the telecommunications sector in Cameroon.¹⁴⁶ It is placed under the supervisory authority of MINPOSTEL. TRB has the duty of regulating, controlling, and monitoring the activities of businesses and operators involved in the telecommunications sector.¹⁴⁷

The National Centre for the Development of Computer Services was the first national body responsible for data processing and related issues. Its main duties include the computerization of ministries and public institutions. However, over time, CENADI's role has been reduced to monitoring computerization programs and solving computer-related problems in the ministry of finance.

D. INFORMATION TECHNOLOGY IN THE SOCIETY AND CULTURE

1. Education

Cameroon is among the sub-Saharan countries that are making enormous progress in the use of information and communications technologies (ICTs) in the various development sectors, including education. Private schools introduced ICTs into their curricula in the 1990s, but there is no specific policy guiding the teaching or use of ICTs in education, which has led to each private school applying its own teaching method or program.

ICTs were officially introduced into education in 2001. The cyber education project launched since then by the government targets secondary and tertiary education. Primary schools are not yet concerned though there are personal initiative in this latter. Major achievements include establishing multimedia resource centers (MRCs) in universities, professional, and technological schools, and some government secondary schools; training monitors to manage MRCs; creating learning platforms; interconnecting

¹⁴⁶ Republic of Cameroon, "Section 22-1 in Law No 98/14," *Cameroon National Assembly*, July 14, 1998.

¹⁴⁷ Republic of Cameroon, "Section 22-2 in Article 3-1 of Decree No 98/197," *Presidency of the Republic of Cameroon*, September 8, 1998.

the ten state universities across the country, and establishing training units in professional schools and universities, some of which are now operational.

However, such projects rely mainly on external funding, thus putting their sustainability in question. Moreover, government secondary schools have poor purchasing power, and no budget has been allotted to support ICT-related activities in schools. Most computers used in schools are donations. Private schools have not been involved in the project, thus creating a gap between the two educational systems. Most of the online learning resources accessible through the government secondary schools learning platform CAM-EDUC are in French, thus constituting a handicap for the English-speaking community. Moreover, all those online resources are based in Europe, indicating the need for empowering national stakeholders to enable them to produce online learning materials corresponding to the local environment.

Specialists are trained mainly in higher education institutions, whose graduates are either specialized technicians (G.C.E. 'A' Level + 2/3) or engineers (G.C.E 'A' Level + 4/5). It is difficult to open courses of study to train specialists in certain ICT fields (computer science, networks, telecommunications, electronics) owing to the low number of lecturers available in such branches (fewer than 20 full-time lecturers for all training establishments). The need to maintain a reasonable teacher/student ratio in these branches makes it impossible for establishments to train a certain number of specialists without jeopardizing the quality of training. With current national training capacities, Cameroon can more or less conveniently train about 100 engineers and 500 technicians annually.

To overcome the inadequacies of the formal educational system and to meet current demands, many rapid training centers, of various calibers, have been set up and offer from introductory courses to office automation and the Internet to university degrees in computer science and related technologies.

However, such training is most often tailored to individual needs to master the new tools. The issue of the institutional recognition of the newly acquired knowledge and

skills by the keen and willing students arises. There is really no system of standardizing training courses and learning (“proficiency certificate/diploma” for example) in order to give better recognition to the skills acquired.

2. Access and Acceptance of Technology

As of 2011, Cameroon’s population was just over 19 million and only 3.8 per cent of them Internet users. The cost of a computer (equivalent to annual per-capita income) makes this tool inaccessible to the majority of Cameroonians and constitutes a major obstacle to Internet access for the population. This is coupled with low offerings and the still-high cost of connectivity. There are still shadow areas in national communications coverage (15%) despite the satellite relay, which cause digital disparities between urban and rural areas.

The number of fixed telephone lines available (174,000) is highly insufficient and does not foster the development in Cameroon of individual and professional uses of this technology; nearly half (48.4%) of enterprises have no fixed telephone line and hardly 5% of them can boast of more than three lines; The cost of telephone calls (especially mobile) is still relatively high; Internet fees are relatively high compared to income levels in Cameroon for provision of service at acceptable speed, which is another obstacle to Internet demand by households.

The rate of computer penetration in institutions is low: 66.2% of institutions have no computer, and only 6.2% have more than one computer. Consequently, the number of employees having access to a computer at the work place is relatively very low; in most ministries, ICTs are used essentially for office automation. Although the ICT equipment pools are often located within the central services, the external or de-concentrated services still rely on the typewriter. In the meantime, very few institutions are connected to the Internet (9.2%) and have a website (10.8%).

In addition, wide disparities in income and educational levels prevent a large penetration of ICTs devices among the population. Cyber cafés are the chief mode of access for the vast majority of Cameroonian Internet users.

3. Social Status

As regards culture, there is an acute global problem of protecting intellectual property. Therefore, nations are trying to adapt their laws to protect such investments and encourage creativity and the converting of cultural and artistic works into formats. The conversion of the natural and cultural heritage of the country into a digital format is a major economic challenge. Indeed, the artistic heritage stands as the leading business in the tourism and leisure industry, where the Internet serves as one of the best showcases. Libraries, archives, museums, and other national institutions of culture are not yet fully playing their role as content providers. In fact, very few of them have digital records or documentation that is easily accessible to the public. The absence of Cameroon's cultural and natural heritage from the web is a major setback for the development of the culture, tourism, and leisure industry in Cameroon.

The lack of attractive career prospects in local government services and enterprises is one of the factors aggravating the massive flight of ICT specialists abroad.

Currently, there are 484,860 Facebook users in Cameroon, which makes it number 100 over 213 in the ranking of all Facebook statistics by country. Additionally, Facebook penetration in Cameroon is 2.51% compared to the country's population and 64.65% in relation to number of Internet users. The total number of FB users in Cameroon, which has grown to more than 17,860 in the last six months, demonstrates the willingness of Cameroon's Internet users to participate in social media. The largest age group of social network users is currently 18–24 with a total of 193,944 users, followed by users aged 25–34.¹⁴⁸

4. Information Technology Dependency

The level of corporate use of ICTs in Cameroon is relatively low. As such, the most commonly encountered uses of ICTs are related to the specificities of the domain, such as commercial duties (purchasing and marketing), management duties

¹⁴⁸ "Cameroon Facebook Statistics," *Social Bakers*, accessed June 26, 2012, <http://www.socialbakers.com/facebook-statistics/cameroon>.

(administrative and finance) and production duties. The use of applications depends entirely on the duties of the enterprise. Enterprises with Internet connectivity quite often are involved with e-transactions, such as online banking transactions, mail exchange, and search of content.

However, the use of e-transaction applications on legal and tax issues, which are common in other countries as a catalyst for economic development, is relatively low in Cameroon. In the public sector, the financial services (taxation, customs, treasury, salaries, and the budget) are relatively more advanced in ICT usage. In fact, these services are far better equipped than other government services. The oldest and largest state computerized management applications with inter-provincial networks are found in this sector.

Therefore, in general, the relatively low level of ICT usage in government services is still bogging down the improvement of relations between these services and their users. New methods, whereby citizens and enterprises can access public administration through new technologies (mobile telephone, Internet), are in their infancy and need to be improved.

E. CRIMINAL ACTIVITIES

Regarding the cybersecurity picture in Cameroon, although there have been some actions taken to prepare the judicial background, much more has to be done to overcome the rising trend of cyber crime encountered in the country. Indeed, the level of criminal activities these last few years calls for serious actions. In his survey of world cyber criminal activities, McAfee, a renowned cybersecurity firm, qualified Cameroon as the “most dangerous in the world for unwary web surfers.” They found that “more than half the sites that McAfee tested in Cameroon's domain space—sites ending in the abbreviation ‘.cm’—were determined to be engaged in shady behavior, such as infecting visitors with password-stealing or spam-sending software.”¹⁴⁹ This situation is essentially

¹⁴⁹ Andy Greenberg, “Cameroon's Cybercrime Boom,” *FORBES*, 12.02.09, accessed June 14, 2012, <http://www.forbes.com/2009/12/01/cybercrime-mcafee-spyware-technology-cio-network-cameroon.html>.

due to the bad management of the domain name inherited by Cameroon and its appeal to scammers in the world, for whom the domain extension is very close to the popular dot-com.

The main concerns remain software piracy, online scammers,¹⁵⁰ and animal and artisanal smuggling.

Cyber activism is of some concern in the country, but the perpetrators are still mostly located out of the country in the Diaspora.¹⁵¹ Their action, though insignificant, has caught the attention of local authorities, causing some strong media outreach from the government.¹⁵²

The website ProjectHoneyPot.org, which conduct surveys of malicious activities online base on honey-pot servers, has generated the results presented in Table 2. These results show the existence of malicious activities from IP addresses within the Cameroon-allocated range of IP addresses.¹⁵³

Table 2. Honey Pot Results on Cameroon¹⁵⁴

N°	Type of Attack	Period of activity of the 50 most recent IP	Total number of attempts registered
1	Harvester IP	Dec 2006 – June 2012	86
2	Spam Server IP	Feb 2007 – June 2012	30504
3	Bad Web host IP	May 2010 – June 2012	02
4	Comment Spammer IP	Dec 2007 – June 2012	44827
5	Dictionary Attacker IP	Feb 2007 – June 2012	44513
6	Rule Breaker IP	– June 2012	0
7	Search Engine IP	– June 2012	0

¹⁵⁰ Roland Abeng, “Cameroon: A Scammer’s and Cybercriminal’s Paradise!” *Fraud Watchers*, accessed June 26, 2010, <http://www.fraudwatchers.org/forums/showthread.php?t=45610>.

¹⁵¹ Dibussi Tande, “The Biya Regime and Cameroon’s Diaspora-driven Cyberspace (Part 2),” May 03, 2011, accessed June 14, 2012, <http://www.dibussi.com/2011/05/the-biya-regime-and-cameroons-diaspora-driven-cyberspace-part-2.html>.

¹⁵² Mohamed Keita, “Fearing Egypt-style revolt, Cameroon bars Twitter service,” *Committee to Protect Journalist*, March 14, 2011, accessed June 2012, <http://www.cpj.org/blog/2011/03/fearing-egypt-style-revolt-cameroon-bars-twitter-s.php>.

¹⁵³ “Cameroon: Directory of Spam Server Ips,” *Honey Pot Project*, accessed July 13, 2012, http://www.projecthoneypot.org/list_of_ips.php?t=s&ctry=CM&by=1.

¹⁵⁴ “Cameroon: Directory of Spam Server Ips,” *Honey Pot Project*.

F. CONCLUSION

Cameroon possesses a huge potential that could make it a major ICT development pole in the Central African region. In fact, the educational system, particularly higher education, despite its many problems, is fairly developed and could serve as a formidable ICTs launching point in Central Africa. On the other hand, the country is endowed with a fiber-optic backbone along the Chad–Cameroon pipeline that is still underutilized. Likewise, a landing point of the South African Telecommunication 3 (SAT 3) sub-marine cable is open at Douala, with a capacity of 2.5 Gbit.

APPENDIX B. THE CENTRAL AFRICAN REPUBLIC

The Central African Republic (CAR), a country of some four million people, is endowed with rich forest and mineral resources and geographically landlocked, located at the crossroads of sub-Saharan Africa. Approximately 20 percent of the population lives in Bangui, the capital city.¹⁵⁵ The country is also at the crossroads of transition from extended instability to a new phase of peace and nation-building and economic recovery, with sustained support from the international community. The data in Table 3 describes below, provides a brief overview of the socioeconomic indicators pertaining to the country.

The security situation remains tenuous. Despite the ceasefire signed by the government with the major dissident political group on 12 June 2011, which has brought stability to the northeast, concerns remain regarding the presence of the Lord's Resistance Army in the southeast, and the fact that the main rebel groups in the north have not been disarmed. Continuing progress on security-sector reform, including restructuring of defense as well as modernization and support to the police and judiciary, are critical elements of the transition for the government.

In this context, it is understandable that the development of cyberspace has not been a priority of the country. In 2006, The Korean Agency for Digital Opportunity and Promotion (KADO) and the International Telecommunication Union (ITU) evaluate the country digital-opportunity index (DOI) to 0.09 in a scale of 0 to 1 for a rank of 174/181.¹⁵⁶ "The Digital Opportunity Index evaluates the opportunity, infrastructure and utilization of information and communication technologies worldwide..." Nevertheless, along with other efforts towards nation building, the sector of information technology has seen some improvement these last five years. The CAR has made significant progress in

¹⁵⁵ "Bangui, Central African Republic," *Wikipedia*, accessed October 2, 2012, <http://en.wikipedia.org/wiki/Bangui>.

¹⁵⁶ "Digital Opportunity Index (DOI)," *ITU*, accessed October 2, 2012, <http://www.itu.int/ITU-D/ict/doi/material/WISR07-chapter3.pdf>.

some areas of its infrastructure. Important reforms providing for the liberalization of the water, power, and information and communications technology sectors have boosted performance. In particular, increased competition in the ICT market has contributed to the rapid expansion of mobile and Internet services. ICT is continuously making an important contribution to economic prospects (1.05 percentage points) as the expansion of mobile and Internet markets continue. Mobile penetration rose from 0.3 subscriptions per 100 people in 2000 to 15.2 in 2009, but is still below the rates of fragile states.¹⁵⁷ With only around half the population covered by a mobile signal, penetration remains behind the levels of comparable sub-Saharan peers.¹⁵⁸

Table 3. Socioeconomic Indicators: The Central African Republic¹⁵⁹

N°	Indicator	Value
1-	Area	623,000 square km
2-	GDP	\$3.672 billion (2011 est.)
3-	Official language	French
4-	Total population	5,057,208 (July 2012 est.)
5-	Population rate between 0-14 years	41% (male 1,021,144/female 1,007,819)
6-	Population 15-64 years	55.3% (male 1,353,600/female 1,382,291)
7-	Life expectancy	50.48 years
8-	Urbanised population	39% of total population (2010)
9-	Average annual growth rate of urban population	2.142% (2011 est.)
10-	Per capita gross national income (US dollars) GNI	1 163
11-	Population below \$1 a day	66.6%

¹⁵⁷ Carolina Domínguez-Torres and Vivien Foster, "The Central African Republic's Infrastructure: A Continental Perspective," *World Bank – AICD*, May 2011, accessed October 2, 2012, http://siteresources.worldbank.org/CENTRALAFREXTN/Resources/AICD-CAR_Country_Report.pdf.

¹⁵⁸ Domínguez-Torres, "The Central African Republic's Infrastructure: A Continental Perspective...."

¹⁵⁹ "Country Profile: The Central African Republic," *CIA – The World Factbook*, accessed October 2, 2012, <https://www.cia.gov/library/publications/the-world-factbook/geos/ct.html>.

A. INFRASTRUCTURE

The technological landscape in the Central African Republic is very limited. The core network, which is essentially implemented in urban area is comprise of fixed dial-up telephone lines, HF and VHF communications for long distance links. Satellite communications devices are exclusively use for connection with the external world to permit the interconnection to international exchange hubs for phone, television, or Internet. Others forms of technologies like optical fiber interconnection cable, and very small aperture terminals (VSAT) are very recent and remain at the experimental level. For urban communication, the only technologies available are GSM, WIFI, WAN, WIMAX. 3G and 4G technologies are very rare, but they do exist.¹⁶⁰

Information technologies are provided to the population through a limited number of operators. The Société Centrafricaine des Télécommunications, alias SOCATEL, a state-owned company, is the sole provider of land-line telecommunication services. Fixed-line subscriptions have been stagnant for several years, at about 0.2 subscribers per 100 people, and 97 percent of the 9,000 existing lines are in Bangui. On average, only 20 new lines per month are connected to the network. Given the shortage of traditional fixed lines, higher levels of ICT access come through wireless technologies. Thanks to the transfer of its monopoly on mobile telecommunication sector to private companies, four companies are now competing to provide GSM services to nearly 1,215,093 subscribers (2010 estimate); MOOV RCA, Orange RCA, Nation Link, and TELECEL RCA.¹⁶¹

¹⁶⁰ “Millennium Selects Airspan 4G Network for Central African Republic,” *Airspan Networks Inc.*, May 30, 2012, accessed October 2, 2012, <http://www.marketwire.com/press-release/millennium-selects-airspan-4g-network-for-central-african-republic-pinksheets-airo-1663033.htm>.

¹⁶¹ Robert N'DEKELE, "Evolution du secteur des telecommunications en republique centrafricaine," *United Nations UNCTAD*, April 2011, http://archive.unctad.org/sections/wcmu/docs/cImem3_3rd_Country_Paper_CAR.pdf.

Internet services are provided to the population by twelve¹⁶² operators using principally dial-up and wireless local loops technologies for distribution. Indeed, the poor condition of SOCATEL's network has made the launch of DSL Internet services unlikely. Recently, Orange launched a wireless broadband service using WiMAX technology, but prices are still high at \$671 per month for a 256 kilobyte-per-second (kbps) connection. Being landlocked, the CAR is reliant on costly satellite VSAT connectivity for international Internet access. To overcome this disadvantage, efforts are under way to establish fiber-optic links to undersea cables landing in neighboring Cameroon. The CAB, which runs across Cameroon, Chad, and the CAR will be operational in 2012. There is a project to interconnect CAR to the neighboring capitals of the subregions (the Congo, DRC, and Gabon) to help diversify the country sources of access to Internet. Continuing in the same perspective of diversification of its access means, CAR is a member of the African satellite project, RASCOM.¹⁶³

The Central African Republic does not possess or plan to possess an Internet Exchange Point (IXP), but as a member of the CAB project, the IXP that is planned to be built in phase II of the project will be shared by the three countries in the alliance.

With regard to the energy sector, there is only one operator in the power sector, ENERCA, which produces, distributes, and markets electricity throughout the country. A newly appointed electricity regulator (ARSE) was created, but its capacity is still limited.

Years of sociopolitical crisis in the CAR have left the power infrastructure in an embryonic state. Total installed capacity in the CAR is 39 MW, one of the lowest in sub-Saharan Africa. The limited infrastructure available is decaying, due to scarce maintenance, and needs to be refurbished. The limited generation capacity consists of Boali 1 and Boali 2—the two main hydropower plants—with a capacity of 14.9 MW each, a diesel plant in Bangui with a capacity of 6 MW, an interconnected grid between Boali and Bangui that carries 34 MW of generated power, and a small distribution

¹⁶² “Broadband Internet Service Providers (ISP) in Central African Republic,” *Who Is This*, accessed October 02, 2012, <http://www.whoisthisip.com/isp-ip-usage-country-Central%20African%20Republic.php>.

¹⁶³ “Members of the RASCOM Project,” *RASCOM*, March 2005, accessed June 28, 2012, http://www.rascom.org/info_detail.php?langue_id=1&id_r=7&id_sr=0&id_gr=2.

network. In 2007 the government started construction of Boali 3, an additional 10 MW hydropower plant that is not yet operational. Further limitations derive from aging infrastructure stock and the pilfering of power equipment. There are frequent breakdowns at power plants, which reduce the supply of already-scarce energy resources—as happened in 2008, when the country faced a power crisis. Thermal generation is curtailed by the expensive price of diesel in the CAR, due to its transportation by routes from neighboring countries. This situation has affected secondary centers that rely on thermal sources for power. The limited availability of power translates into poor access to electricity. As of 2009, only one percent of the CAR's population had access to electricity, totally concentrated in urban areas, especially the capital city Bangui. No one in rural areas benefits from electrification. The available electricity is erratic and unreliable. Outages in 2006 lasted as much as 950 hours during the year, with an average duration of 5.2 hours. Load shedding cut off power as much as eight hours a day in 2008 and has reportedly increased to 13.5 hours a day on average. Among other factors, the CAR's poor electricity infrastructure and fiber-optic links are major barriers to the expansion of the ICT sector.

The Central African Republic has no ICT industrial facilities; all ICT equipment is imported, including access equipment (radio and television sets, computers, telephones) as well as routine maintenance equipment. Thus, the country is totally dependent on imports as far as the acquisition of equipment and software for ICT development are concerned.

B. INFORMATION SYSTEMS, BUSINESS, AND INDUSTRIES

Apart from proprietary systems use for telecommunication infrastructures, the bold majority of operating systems in use in the Central African Republic are Windows based. The services offered in the CAR cyberspace are exclusively web hosting, communications (VOIP, SMS, E-Fax, e-mail), and web navigation. The CAR is an ICT products consumer.

In the public sector, CAR is ranked 181/192 on the index of electronic government by the United Nation.¹⁶⁴

C. LAWS, REGULATIONS, AND ORGANIZATION

1. Strategies and Policies

In collaboration with various partners such as the European Union (EU) and the Economic Commission for Africa (ECA), the CAR is currently building its global ICT policy, which has regained a momentum.¹⁶⁵

Indeed, in January 2002, a decree by the government kick-started the National Information and Communication Infrastructure (NICI) plan process. Consultation workshops were organized for members of the government, academia, private sector, telecom operators, and regulators. Subsequently, a baseline study was undertaken in June and July 2002. Despite an ongoing conflict that stalled the process, the country has achieved a genuinely competitive market with no real dominant player, except in the landline market. The government is planning to hold a national workshop to validate and elaborate the draft NICI plan and achieve consensus.¹⁶⁶

2. Laws, Regulations, and Organization

The legal and regulatory framework for the telecommunications sector does exist. A number of laws and regulations have been enacted for the sector, including Law No. 07,020 of December 28, 2007, on the regulation of telecommunications; Law No. 07,021 of December 28, 2007, setting the fees and charges on property and/or operation of

¹⁶⁴ This index refers to the generic capacity or aptitude of the public sector to use ICT for encapsulating in public services and deploying to the public, high quality information (explicit knowledge) and effective communication tools that support human development. The index is comprised of three sub-indexes: Web Measure Index, Telecommunications Infrastructure Index and Human Capital Index, See http://www.ictforlde.com/index.php?option=com_k2&view=item&layout=item&id=14&Itemid=10.

¹⁶⁵ Central African Republic, "Déclaration de politique sectorielle des telecommunications – TIC en République Centrafricaine," March 9, 2007, accessed October 2, 2012, www.observatoiretic.org/documents/download/108.

¹⁶⁶ Economic Commission for Africa, "E-Strategies: National, Sectoral and Regional ICT Policies, Plans and Strategies," *AISI Sub-committee on Information and Communication Technology: ICT and Governance*, April 3, 2003, accessed October 2, 2012, <http://www.uneca.org/aisi/docs/e-strategies.pdf>.

networks and telecommunications services applicable throughout the national territory;¹⁶⁷ Law No. 08,011 of February 13, 2008, on the organization's institutional and legal framework, applicable to businesses and public offices; Decree No. 96,241 of August 27, 1996, approving the statutes of the agency for regulation of telecommunications; and Order No. 03,004 of May 27, 2007, setting the fees and charges in operating telecommunications throughout the country.¹⁶⁸

Apart from some few NGO-sponsored organizations in charge of the promotion of ICT in the country, the “Agence de Régulation des Télécommunications,” which has been in operation since April 2004, is the public institution responsible for regulating, controlling, and monitoring the activities of the telecommunications sector in the Central African Republic. It is placed under the supervisory authority of the ministry of posts and telecommunications. This agency has the duty of regulating, controlling, and monitoring the activities of businesses and operators involved in the telecommunications sector.

Regarding its relations with the world, the CAR is a member of several international organizations of which is the ITU. At the regional level, it is active in the work of the Central African Economic and Monetary Community (CEMAC) in the area of telecommunications and has participated in the region's efforts to harmonize the legal framework for telecommunications at the CEMAC level. Five guidelines for ministers responsible for telecommunications and new technologies of the CEMAC were adopted in 2008 and have yet to be enacted at the country level. These were in relation to: i) the protection of the rights of users of networks and electronic-communications services; ii) the harmonization of procedures for establishing and monitoring rates of electronic-communications services; iii) interconnection and access to networks and electronic-communication services, iv) universal service schemes in the electronic-communications sector, and iv) harmonization of the legal systems of electronic-communications

¹⁶⁷ Central African Republic, “Law No 07-020,” *CAR Presidency of the Republic*, December 28, 2007, <http://www.art-rca.org/Lois/LOI%2007.020.pdf>.

¹⁶⁸ Robert N'Dekele, “Evolution du secteur des télécommunications en république centrafricaine,” *United Nations UNCTAD*, April 2011, accessed October 2, 2012, http://archive.unctad.org/sections/wcmu/docs/cImem3_3rd_Country_Paper_CAR.pdf.

activities. The broader framework in which reforms are taking place include service liberalization in the context of the WTO and negotiations under the Economic Partnership Agreement with the European Union.

Although there is now a judicial foundation for cyber activities in CAR, the country still needs to pass specific laws on cybercrime and cybersecurity, build the infrastructure, and train personnel to enforce these new laws. The national security forces are still inadequately suited for the task.

D. INFORMATION TECHNOLOGY IN THE SOCIETY AND CULTURE

1. Education

The Central African Republic (CAR) faces many challenges in making a greater effort in training, budgeting, and raising awareness concerning the use of ICTs. Introducing ICTs into basic education (especially in secondary education) is increasingly seen by many as a necessity, and the development of teacher skills is necessary to enhance the use of educational technology. The country has only one university and enrolment rates are low for most levels of education. To reverse this situation, the government has made some worthy efforts to promote basic education, such as the building of new schools in the capital and the provinces with assistance from the European Union and the World Bank.

The National Education Development Plan (PNDE) sets the general strategy for reaching the objectives of quality, efficiency, accessibility, and equity in education for the next 10 years. The cyber education project launched since then by the government targets two sectors: secondary and tertiary education. Major achievements include establishing multimedia resource centers (MRCs) in universities and related institutions; training monitors to manage MRCs; and creating learning platforms.

Specialists are trained mainly in higher-education institutions, whose graduates are either specialized technicians (G.C.E. 'A' Level + 2/3) or engineers (G.C.E 'A' Level + 4/5). It is difficult to open courses of study to train specialists in certain ICT fields

(computer science, networks, telecommunications, and electronics) owing to the low number of lecturers available in such branches.

The close collaboration between PNUD and UIT, the Central African government, and CISCO Systems has resulted in the creation of a local CISCO academy at the University of Bangui. Additionally, the department of higher education, with aid from the French Cooperation, initiated a program that aims to set up a network of all university institutions. This program has enabled the creation of a multimedia resource center (CRM). The CRM and CISCO Academy thus offer advanced training (a post-bachelor's professional degree) in conceiving, installing, and maintaining computer networks. Twelve students are trained every year in ICT vocations. In the future, the CRM aims to deal with tele-education and produce multimedia in CD-ROM format. A virtual campus for trainings in ICT has recently been installed by the Francophone Agency. Students are asked, at the end of their training, to carry out website creation projects, for example, for the university and the Pasteur Institute of Bangui).

The ADEN project, led by the French Cooperation for Democratizing ICT Access with the aim of breaking the digital gap and encouraging the African production of content,¹⁶⁹ has created a number of centers where students can access computers and the Internet and receive tutorials from teachers. Teachers use these centers to search for information and develop teaching materials. This project has been so successful that the government has approved and authorized total exemption from import tariffs on equipment for ADEN centers all over the country.

¹⁶⁹ Babacar Fall, "ICT in Education in the Central African Republic," *InfoDev*, June 2007, accessed July 13, 2012, <http://ddp-ext.worldbank.org/EdStats/CAFpro07.pdf>, 4.

The International Telecommunications Union launched a project to create a network of at least 100 multipurpose community callboxes (TCPs) in 20 African countries, including the Central African Republic.¹⁷⁰ These TCPs will give communities access to ICT to enable them to participate in the information society. The TCPs will be managed by women, who can thus actively participate in the processes of development and decision-making on the African continent. This project is part of the commitment made by 175 countries that adopted an action plan during the first phase of the Information Society World Summit to make the advantages of ICT within all humanity's reach.

As part of its mission in the Central African Republic, the United Nations Program for Development (PNUD) has developed an ICT plan that concentrates on the social and economic objectives of the Millennium Declaration and has a primary objective of enabling universal access to the information society. These plans focus on policies related to education, health, employment, government efficiency, development of local content, and the social integration and the promotion of science, technology, and innovation. It is adapted to the country's national characteristics, needs, and values and emphasizes the state's central role in the formulation and implementation of a policy tied to ICT, in partnership with international organizations, the private sector, and civil society. Its goals are to:

- Use new and existing technologies to create universal connectivity by distributing information and communication materials so that everyone can benefit from easy access, including the elderly and handicapped
- Develop connectivity, including Internet access, in institutions receiving many people, such as digital community centers, schools, universities, libraries, post offices, community and cultural centers, archives, and museums

¹⁷⁰ "L'UIT lance un projet de télécentres communautaires polyvalents en Afrique," *ITU*, January 10, 2005, accessed October 2, 2012, http://www.itu.int/newsarchive/press_releases/2005/02-fr.html.

- Find appropriate solutions for promoting ICTs adapted to the environment in remote, impoverished, and particularly rural zones, but also in poorly serviced or marginalized urban zones (e.g., by establishing multipurpose community access centers to guarantee integrated access to information and social services)
- Find solutions to make access to ICT affordable in regions with low revenues
- Supply information and applications in the language and cultural context that is most familiar to the user, which will encourage further ICT use
- Include unwritten languages by using audio-digital tools

2. Social Status

The 2011 UNDP Human Development Report ranks CAR near the bottom of its human development index (179th out of 187 countries) and unlikely to meet its Millennium Development goals (MDG). The proportion of Central Africans living on \$1 a day has decreased slightly to 62%, but it needs to be half that in order to reach the 2015 goal, and the prevalence of underweight children under five has increased since 2003 to nearly 30 percent, a rate nearly three times the MDG target. There are also large socioeconomic and regional variations; for example, rates of HIV/AIDs have increased from 3.1% in 1990 to 4.7% in 2009 with rates of up to 15–18% in the west of CAR. Notable increases in service delivery include an increase in primary enrollment (58% in 1990 to 91% in 2009); literacy rates from 34% in 1990 to 55% in 2009; and improved sanitation facilities and improved water sources from 11% and 58% in 1990 to 34% and 67% in 2009, respectively.

3. Access and Acceptance of Technology

Given the underdevelopment of the basic network, access to ICT is for now only possible in urban areas and especially in the capital, where there are around 1,800 Internet subscribers in a population of 600,000. Twenty private cyber cafés and some few

education centers offer Internet access on workdays. The estimated current Internet penetration rate in CAR is 2% of the population.

Currently, there are 148,760 Facebook users in the Central African Republic, which makes it number 132 over 213 in the ranking of all Facebook statistics by country. Additionally, Facebook penetration in CAR is 3.07% of the country's population, and 658.23% in relation to number of Internet users. The total number of FB users in CAR has grown by more than 25520 in the last 6 months, demonstrating the willingness of CAR's Internet users to participate in social media. The largest age group of social network users is currently 18–24, with a total of 63,967 users, followed by users aged 25–34.¹⁷¹ Twitter database does not show any activity coming from the Central African Republic. However, a handful of people from Bangui are active on Twitter.¹⁷² Internet happenings in Central Africa are hard to come by. For one, few independent news sources exist in the region. Those that do exist often cover human rights or politics or sports rather than tech news. However, a few bloggers from CAR keep the rest of the world informed of ICT developments in Bangui. Global Voices, an online website, has one story on the Central African Republic from the past year, and only three from the past two years. Various NGOs and aid organizations provide disaster news. Still, Facebook remains the go-to for those living in the Central African Republic.

An assortment of sources provides a glimpse into how the Internet is touching the lives of those in CAR. Hippolyte Donossio, a web journalist, producer, and reporter from Bangui, has a broad social presence and maintains a WordPress blog. “BlogmandeBangos” posts to the Echos de Centrafrique blog. “Le Confident,” an independent newspaper, provides telecoms business news from SOCATEL. Another source is the government-run “Centrafrique-Presse,” based in Bangui and aligned with the incumbent party.¹⁷³

¹⁷¹ “Central African Republic Facebook Statistics,” *Social Bakers*, accessed June 26, 2012, <http://www.socialbakers.com/facebook-statistics/central-african-republic>.

¹⁷² “Central African Republic: ‘La Facebookmania’ à La Centrafricaine,” *OAfrica*, November 14, 2011, accessed October 2, 2012, <http://www.oafrica.com/city-profile/central-african-republic-facebookmania/>.

¹⁷³ “Central African Republic: ‘La Facebookmania’ à La Centrafricaine.”

4. Information Technology dependency

Although there is a frenetic endorsement of social-media activities among Internet users in Central African Republic, the level of corporate use of ICTs is very low. As such, the most commonly encountered uses of ICTs are related to specific domains such as management duties (administrative and finance) and production duties. The use of the applications depends entirely on the duties of the enterprise. Enterprises with Internet connectivity, though rare, quite often are involved with e-transactions, like mailing and online research. Overall, there is no indication of dependency on technology at all in the CAR society. ICTs are still considered a luxury rather than a daily tool for life.

E. CRIMINAL ACTIVITIES

Regarding the cybersecurity picture in the CAR, nothing serious has been said on that domain. Due to its involvement in regional collaboration, authorities in the CAR have been brought to adopt resolution to develop the framework of cyberspace. But still the road remains long. There is a new trend of trafficking that uses the Internet for wildlife trade and smuggling. This is a form of crime that exploits the opportunities offered by new technologies to access a wide international market.¹⁷⁴ In the Central African Republic, cybercrime activities are rare and essentially spam related. The website ProjectHoneyPot.org, which conducts surveys of malicious activities online based on honey-pot servers, generated the results presented in Table 4. These results show a very low amount of malicious activities coming from IP addresses within the country's allocated range of IP addresses.¹⁷⁵ They essentially revolve around spammed IP addresses.

¹⁷⁴ Ononino, Alain Bernard, "Establishing Regional Wildlife Law Enforcement : Lesons From an Unusual NGOs –Government Partnership in the Central African Subregion," *Ninth International Conference on Environmental Compliance and Enforcement 2011*, accessed October 2, 2012, http://inece.org/conference/9/proceedings/63_Ononino.pdf.

¹⁷⁵ "CAR: Directory of Spam Server Ips," *Honey Pot Project*, accessed July 13, 2012, http://www.projecthoneypot.org/list_of_ips.php?t=s&ctry=CF&by=1.

Table 4. Honey Pot Results in the Central African Republic¹⁷⁶

N°	Type of Attack	Period of activity of the 50 most recent IP	Total number of attempts registered
1	Harvester IP	–June 2012	0
2	Spam Server IP	–June 2012	11 147
3	Bad Web host IP	–June 2012	0
4	Comment Spammer IP	–June 2012	38
5	Dictionary Attacker IP	–June 2012	11 747
6	Rule Breaker IP	– June 2012	0
7	Search Engine IP	– June 2012	0

F. CONCLUSION

In spite of its limited development of the moment, the ICT sector constitutes an engine of development in the future, thanks to very favorable trends. The prospects are promising with regard to the intentions of investment announced by big operators of telephony such as the group Orange, with all the potential fiscal fallout for the state.

Considering the big challenges of development of the country, most of the actions of development during the last decades, in particular in the social sectors, basic infrastructures, and rural development, were done to the detriment of domains like ICT. As a result, administrations and companies use very little ICT; small and medium-sized enterprises, in particular tourist and cultural, are absent on the web. The public sector does not offer information and online services to citizens and economic operators. The needs of the specialized workforce hardened to ICT are underestimated and cannot be satisfied by training capabilities. ICTs are not introduced into programs of education and research yet.

The telecommunications sector faces the constraints of legal, statutory and institutional weaknesses in the framework of the sector; basic infrastructures that are ruined due to lack of investment and acts of destruction; nonexistence of a dynamic,

¹⁷⁶ “CAR: Directory of Spam Server Ips,” *Honey Pot Project*, accessed July 19, 2012, http://www.projecthoneypot.org/list_of_ips.php?t=s&ctry=CF&by=1.

competitive climate, allowing the development of ICT; and weakness in coverage of the national territory, offering few means of access to ICT.

The government has begun to clarify the regulatory framework of the sector, in particular by specifying the rules of granting of licenses and by creating a regulatory agency. A new law fixing the legal framework of the sector is in the process of elaborating the basis of a detailed consultation of all the actors. Security issues with regard to ICT use are still to be addressed.

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APPENDIX C. THE REPUBLIC OF CHAD

Chad is a Sahelo-Saharan country of 1.28 million square kilometers and a population of nearly 11 million. The country, located in the heart of Africa, is landlocked and presents a harsh climate. Though its soil is oil- and mineral rich, Chad is classified among the poorest countries on the human-development index. The level of poverty is characterized by a very low rate of schooling, strong population growth, a low rate of healthcare, and more. The data in Table 5 provides a brief overview of the socioeconomic indicators pertaining to the country.

Chad has been plagued in recent years by multiple internal and external crises. Internally, the government of Chad continues to face off against the attacks of armed opposition groups based in the eastern part of the country and neighboring Sudan. This conflict has caused general instability in much of the country and hindered development efforts.

According to a recent ranking of the International Telecommunication Union (ITU), Chad is one of the countries with the lowest rate of penetration of information technologies and communications to the world (ICT). Ranked 138 over 142 in the Networked Readiness Index (2.6/7) by the *2012 Global Information Technology Report* of the World Economic Forum,¹⁷⁷ the government of Chad is showing a tremendous desire and effort to overcome the technological gaps of its country.

The following indicators show the status of achievement for the efforts being conducted. The penetration rate of telephony services is estimate to be 35.4% of the population, with a landline teledensity of 0.4% and mobile teledensity of 35% in 2012.

¹⁷⁷ Soumitra Dutta and Beñat Bilbao-Osorio, “The Global Information Technology Report 2012: Living in a Hyperconnected World,” *World Economic Forum*, 2012, accessed June 10, 2012, http://www3.weforum.org/docs/Global_IT_Report_2012.pdf, 200.

The Internet penetration rate is estimate to involve around 2.3% of the population.¹⁷⁸ Indeed, until this year, Chad lacked a national backbone infrastructure and international fiber-optic access to support broadband services. All long-distance connections, both national and international, are currently made via satellite. However, this situation is gradually improving under the CAB project.

Radio is by far the most widely used communication medium. Most privately owned and operated radio stations are based around N'Djamena in the southwest. A number of these stations are run by nonprofits and have a limited broadcast range.¹⁷⁹ Television is sparsely used in Chad. Television use is limited by the expense of owning a set, poor access to electricity, and government restrictions on broadcasting.

Table 5. Socioeconomic Indicators: Chad¹⁸⁰

N°	Indicator	Value
1-	Area	1.284 million sq km
2-	GDP	\$19.69 billion (2011 est.)
3-	Official languages	French and Arabic
4-	Total population	10,975,648 (July 2011 est.)
5-	Population rate between 0-14 years	46% (male 2,510,656/female 2,441,780)
6-	Population rate between 15-64 years	51% (male 2,531,896/female 2,960,406)
7-	Life expectancy	48.69 years
8-	Urbanized population	28% of total population (2010)
9-	Average annual growth rate of urban population	4.6% annual rate of change (2010-15 est.)
10-	Per capita gross national income (US dollars) GNI	\$ 1,125 ¹⁸¹
11-	Population below \$1 a day	55% ¹⁸²

¹⁷⁸ “Chad - Telecoms, Mobile and Internet,” *BuddeComm*, accessed October 9, 2012, <https://www.budde.com.au/Research/Chad-Telecoms-Mobile-and-Internet.html>.

¹⁷⁹ “The Development Context in Chad: Internal and External Crises,” *AudienceScapes*, June 16, 2010, accessed October 9, 2012, <http://www.audiencescapes.org/country-profiles/chad-development-context-internal-and-external-crises-humanitarian-aid-refugee-agriculture-oil>.

¹⁸⁰ “The World FactBook: Chad,” *CIA*, September 11, 2012, accessed October 9, 2012, <https://www.cia.gov/library/publications/the-world-factbook/geos/cd.html>.

¹⁸¹ “GNI per capita, Atlas method (current US\$),” *The World Bank Group*, accessed February 11, 2012, http://devdata.worldbank.org/ict/tcd_ict.pdf.

¹⁸² “Africare-Chad,” *Africare*, accessed October 9, 2012, <http://www.africare.org/our-work/where-we-work/chad/index.php>.

A. INFRASTRUCTURES

The technological landscape in Chad is quite diverse. It offers a variety of technologies necessary for broadband data transportation to end-user distribution. The core network, which is essentially old and obsolete, is concentrated in urban areas and consists of fixed dial-up telephone lines and HF/VHF communications for long-distance links. Satellite-communication devices are extensively use to link and reach remote areas and connect with the external world for phone, television, or Internet. With the execution of the new NICI policies, others forms of technology have been introduced, like fiber-optical interconnection with undersea cables from Cameroon and very small-aperture terminals (VSAT). For urban communications, technologies like ADSL, GSM, 3G, CDMA, WIFI, WIMAX, and others are progressively introduced.

Information technologies are provided to the population, through there is a very limited number of operators. The Société des Télécommunications du Tchad, alias SOTEL TCHAD, a state-owned company, is the sole provider of land-fixed telecommunication services. Along with two other companies, CELTEL Tchad and TIGO Tchad, SOTEL provides the country with mobile (wireless) communication services, with a total of 3.8 million subscribers in 2012.¹⁸³

SOTEL is also the company in charge of the exploitation of the optical-fiber cable network that connects Chad to Cameroon's SAT3/WASC undersea terminal, which makes SOTEL one of the principal distributors of Internet to the rest of the low-level services providers. Internet services are provided to the population by nearly twelve¹⁸⁴ operators, using a mosaic of technologies, from dial-up to VSAT through wireless local-loops systems.

¹⁸³ Republic of Chad, "NICI Plan Tchad," *Ministry of Posts, Telecommunications, and New Technology*, May 2007, accessed October 9, 2012, http://www.uneca.org/aisi/nici/Chad/Plan%20NICI_Tchad.pdf, 16.

¹⁸⁴ "Broadband Internet Service Providers (ISP) in Chad," *Who Is This IP*, accessed October 9, 2012, <http://www.whoisthisip.com/isp-ip-usage-country-Chad.php>.

In the last five years, Chad has been developing a program of interconnecting all the country with a network of optical fiber for a backbone of nearly 2500 Km.¹⁸⁵ This program, which is supposed to reach completion in 2012, will provide to the country a high level of interconnection. Additionally, with the other countries of the Central African region, Chad has acquired 640 Km of optical fiber to interconnect with the republics of Cameroon and Central Africa.¹⁸⁶

Along with the Central African backbone, there is a project to interconnect Chad to the capitals of the neighboring subregions (Nigeria, the Central African Republic, and Sudan) to help diversify sources of access to the Internet. Continuing in the same perspective of diversification of its access means, Chad is a member of the African satellite project, RASCOM.¹⁸⁷

Chad does not possess, or plan to possess, an Internet Exchange Point (IXP), but as a member of the CAB project, the IXP that is planned for Phase II of the project will be shared by the three countries in alliance.¹⁸⁸

In Chad, there is no evidence of server farms, except for server infrastructures in use by telecommunication operators to deal with their customers.

Chad's energy infrastructure is exceptionally poor, even by the standards of other developing countries. Decades of civil war have taken their toll, and improvements have proceeded slowly. Mismanagement of the government-run power monopoly slowed the development of infrastructure in this essential sector. Chad's people have limited access

¹⁸⁵ Republic of Chad, "NICI Plan Tchad," *Ministry of Posts, Telecommunications, and New Technology*, May 2007, accessed October 9, 2012, http://www.uneca.org/aisi/nici/Chad/Plan%20NICI_Tchad.pdf, 16.

¹⁸⁶ Hervé B. Endong, "Fibre optique: Le Cameroun et le Tchad désormais interconnectés," *La Nouvelles Expression*, March 20, 2012, accessed June 22, 2012, <http://www.lanouvelleexpression.info/actu/7319.html>.

¹⁸⁷ "Members of the RASCOM Project," *RASCOM*, March 2005, accessed June 28, 2012, http://www.rascom.org/info_detail.php?langue_id=1&id_r=7&id_sr=0&id_gr=2.

¹⁸⁸ "Central African Backbone Project - APL1A in Chad: Harmonization and Modernization of the Legal and Regulatory Framework for Electronic Communications," *World Bank – WB DEVEX*, July 28, 2010, accessed June 22, 2012, <http://www.devex.com/en/projects/central-african-backbone-project-apl1a-in-chad-harmonization-and-modernization-of-the-legal-and-regulatory-framework-for-electronic-communications>.

to power and electricity. In 2008, Chad generated 0.1 billion kilowatt hours of electricity from an installed capacity base of 32 megawatts.¹⁸⁹

Electricity and water services are confined to the capital, N'Djamena, where the country's only major power station (22 MW) is located, and to a few regional capitals. Only 9% of households in N'Djamena have electricity. Even in these limited areas, electricity is extremely expensive and services are often cut off. Daily power outages remain serious issues that put at risk the electricity infrastructures. Overall, less than 2% of Chad's population has access to electricity. The rest of the population, urban or rural, relies on wood for fuel requirements and access to electricity on an individual level is ensured by using power generators, exclusively reserve for essential needs.¹⁹⁰

Nevertheless, some improvements are expected as the government liberalizes the energy and telecommunications sectors and gradually improves the transport infrastructure. World Bank loans to develop electricity have focused on increases in sustainable energy (\$5.3 million) and improvements in equipment renovation (\$55 million).¹⁹¹

Chad has no ICT industrial facilities. All equipment is imported, from access equipment (radio and television sets, computers, and telephones) to maintenance equipment. Thus, the country is totally dependent on importation, as far as ICT is concerned.

B. INFORMATION SYSTEMS, BUSINESS, AND INDUSTRIES

The ICT infrastructure in Chad operates with a quite diverse set of operating systems (OSs). As usual, industrial infrastructures use proprietary OSs and their types are likely tied to the companies' internal policies. But at the level of the end-user, the most

¹⁸⁹ "Chad – Energy Profile," *Energici*, accessed June 28, 2012, <http://www.energici.com/energy-profiles/by-country/africa-a-l/chad>.

¹⁹⁰ "Chad - Infrastructure, power, and communications," *Encyclopedia of the Nations*, accessed June 28, 2012, <http://www.nationsencyclopedia.com/economies/Africa/Chad-INFRASTRUCTURE-POWER-AND-COMMUNICATIONS.html>.

¹⁹¹ "Country Energy Information - Chad," *Developing Renewable*, September 2006, accessed June 28, 2012, <http://www.energyrecipes.org/reports/genericData/Africa/061129%20RECIPES%20country%20info%20Chad.pdf>, 2-3.

commonly use systems are Microsoft Windows, Linux, and Macintosh base. The use of Open Source OS remains much less academic than professional.

The services offer in Chadian cyberspace revolve around web hosting, communications (VOIP, SMS, E-Fax, e-mail), and web navigation. Electronic commerce is yet to be introduced. Some few small and medium enterprises (SME) marketing ICT products and services exist and are based mainly in N'Djamena. Most of them are local branches of foreign firms or have concluded local representation agreements with such firms (e.g., for software solutions, networking solutions, and IT security).

One sector that has significantly embrace cyber technology is the banking sector, especially micro-finance companies. They usually rely on IT to proceed in their daily remote transactions. IT has becomes crucial in money transfer as the use of short message service (SMS) helps to transmit and encoded text via GSM technology carrying instructions on a money-transferring operation.¹⁹²

In the public sector, though Chad is ranked 189/190 on the index of electronic government by the United Nations in his 2012 survey,¹⁹³ a lot is being done to use information technology. The presidency and three other ministries were already interconnected by a local area network by late 2010, with the ambition to extend that network to the rest of the government, down to the provincial level.¹⁹⁴ One project that is

¹⁹² Anna McGovern, "Afrique: transferts d'argent au bout du fil," *Africa Time*, February 21, 2012, accessed October 9, 2012,

http://africatime.com/Tchad/nouv_pana.asp?no_nouvelle=654037&no_categorie=3.

¹⁹³ United Nations, "E-Government Survey 2012," *United Nations*, New York (2012), accessed June 29, <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan048065.pdf>, 44.

¹⁹⁴ Dany Dazoumbe Padire, "Télécommunications: Le Tchad se met à la technologie chinoise," *CIPACO*, November 2007, accessed June 24, 2012, <http://www.cipaco.org/spip.php?article1565>, 1-2.

worth noting is conducted by the state finance service: “Projet pour l’Amélioration de la Gestion des Finances Publiques (PAMFIP)”¹⁹⁵ aims to computerized the management of public finance.

C. LAWS, REGULATIONS, AND ORGANIZATION

1. Strategies and Policies

Following the example of many African countries, the government of Chad made development of information technologies and communication one of its priorities. The government has clearly recognized that besides the advantages they offer, ICTs constitute an effective instrument to fight against poverty and promote competitiveness in the economy and efficiency of governmental action.

However, constraints still exist on the road towards the information society. The development of infrastructures, the strengthening of capacities, and an appropriate legal and statutory framework are major ICT needs. The Chadian government, conscious of this situation and eager to face the challenges of ICT development, undertook in 1998 reforms of the telecommunications sector, which have led to greater liberalization, allowing the private sector to play a driving role in this sector. To follow up this effort, the Chadian government requested the support of the Economic Commission for Africa (ECA) and other partners for the development of a joint and coordinated plan of development (NICI).

The National Strategy of Development of ICT, which was adopted in 2007, became a cornerstone that will allow Chad to channel all the energies towards common and shared objectives. The national strategy was translated into an action plan over five years with strategic objectives, clearly defined responsibilities, and a timetable of implementation. This national strategy, which integrates perfectly into the national

¹⁹⁵ World Bank, “Public Financial Management Capacity Building in Chad: Recruitment of a Firm Responsible for Setting Up a System for Managing Public Investment,” World Bank DEVEX, August 12, 2011, accessed October 9, 2012, <http://www.devex.com/en/projects/public-financial-management-capacity-building-in-chad-recruitment-of-a-firm-responsible-for-setting-up-a-system-for-managing-public-investment>.

strategy of reduction of poverty, aims essentially at raising all the constraints which inhibit access to ICT and to set up an environment for a steady development of information technologies and communication.

2. Laws, Regulations, and Organization

The legal and regulatory framework for the telecommunications sector in Chad is still rudimentary. Two laws enacted in 1998 constitute the root platform of telecommunication in Chad.¹⁹⁶ These two laws, which are at the root of the liberalization of the telecommunications sector, have allowed the creation and the implementation of the following structures: first, a ministry of posts and new technology of communication (MPNTC); this is the institution in charge of the national policy in ICT. Second, an office of regulation of telecommunications (OTRT); this is the authority in charge of the regulation, application, and implementation of the law and statutory texts of the telecommunications sector. Third, the Société des Télécommunications du Tchad (SOTEL Chad), initially owned by the State; it is mainly charged with the exploitation of the basic network. According to the aforementioned law, SOTEL Tchad runs the activities of telecommunications. In 2005, SOTEL Chad capital was opened to private investors. Since then, 60% of its capital has been taken by the private sector (foreign investors), 10% was given to the staff of SOTEL-Tchad, and the remaining share —30% of the capital—kept by the Chadian state. Finally, the “Société des Postes et de l’Epargne (STPE),” which is totally owned by the state. This company is in charge of postal services and savings.

Chad is a member of several international organizations, one of which is the ITU. At the regional level, it is active in the work of the Central African Economic and Monetary Community (CEMAC) in the area of telecommunications and has participated in the region's efforts to harmonize the legal framework for telecommunications at the CEMAC level.

¹⁹⁶ Two laws enacted in August 17, 1998, one N°008/PR/98 creating and organizing the Postal services and the other N°009/PR/98, organizing telecommunications services.

Overall, the legal framework of ICT in Chad is characterized by the existence of numerous gaps in the law. Indeed, substantive law ignores the numerous activities that develop in the ICTS sector worldwide. The concept of new information technologies and communication and the Internet does not appear in the law on telecommunications. Also, the text of law is silent on the repression of possible breaches by via information technologies and of communication. Moreover, the institutional framework of ICT is characterized by the existence of several organisms with conflicting goals. Indeed, the increasing convergence of sectors of the broadcasting, telecommunications, and computer systems towards the all-digital exposes the different regulatory bodies of these sectors to frequent jurisdiction conflicts that could damage their efficiency.¹⁹⁷

D. INFORMATION TECHNOLOGY IN THE SOCIETY AND CULTURE

1. Education

The history of the educational system of Chad has been negatively impacted by the civil wars that have divided and impoverished the country for 20 years, following its independence from France. Since 1996, some degree of political and social stability has taken hold, and it has had a positive influence on education. There have been improvements. The literacy rate has increased from 15 percent in 1960, to 20 percent in 1985, 48% in 1996, to 46.26 in 2009, according to a World Bank report published in 2010.

Chad's education system follows the French model. A Chadian's typical formal education begins at kindergarten, followed by six years of primary (elementary) education, seven years of secondary education, and seven years of higher education. Although Chad is a bilingual country (French and Arabic), French is the language of

¹⁹⁷ Republic of Chad, "NICI Plan Tchad," *Ministry of Posts, Telecommunications, and New Technology*, May 2007, accessed October 9, 2012, <http://unpan1.un.org/intradoc/groups/public/documents/unpan/unpan033697.pdf>, 21.

instruction in the majority of educational institutions.¹⁹⁸ Despite vigorous efforts aimed at training new faculty, it is estimated that 30 percent of primary school teachers hold no professional qualifications. The teacher–student ratio is 1:65 in rural areas and can be as high as 1:100 in large agglomerations such as Moundou, Sarh, Bongor, Abéché, Dobra, and N'Djamena, the capital. The Chadian government has launched efforts to promote the teaching of the standard curriculum in many of the local tribal languages. However, many parents, working through the influential parents' associations, tend to resist this, as they insist that their children be taught in French, especially in southern Chad.¹⁹⁹

Higher education in Chad is provided by public and private institutions. Public institutions, which count three universities and seven schools and institutes, include the University of Ndjamen, the Institut Universitaire des Sciences et Techniques in Abeche, and the Institut Universitaire des Techniques Agricoles in Sarh.²⁰⁰ The University of N'Djamena, which was established by government decree in 1971, serves as the main centre of higher learning. The University of N'Djamena is committed in a project of IT modernization, allowing the students to have broadband access to the resources of the Internet. The university is evaluating new multimedia technologies, among which are courses offered by private teaching companies. Finally, the university has created a partnership with other regional and international institutions, especially an international extension (Euclide) who works as a relocated digital campus.

Private colleges are also represented; and the most prominent are King Faisal University in Sarh and the Institut Supérieur de Gestion in Abeché. Both institutes were recently opened and offer a two-year training program leading to an associate degrees known as a Brevet de Technicien Supérieur (BTS).

¹⁹⁸ Felix Mbatalbaye, "Country Profile : Chad's education system," Chadian Ministry of Education, accessed June 25, 2012, http://www.bibl.u-szeged.hu/oseas_adsec/chad.htm.

¹⁹⁹ "Chad - Preprimary & Primary Education," *The StateUniversity.com Education Encyclopedia*, accessed June 25, 2012, <http://education.stateuniversity.com/pages/255/Chad-PREPRIMARY-PRIMARY-EDUCATION.html>.

²⁰⁰ "Virtual initiatives in post-secondary education," *Researching Virtual Initiatives in Education*, accessed June 25, 2012, <http://virtualcampuses.eu/index.php/Chad>.

Chad has a two-tier system of vocational and technical education. Students can enter a six-year program leading to the CAP, or Certificat d'Aptitude Professionnelle (professional skills certification), in a variety of manual and technical fields.

Specific ICT-relevant educational programs are still very few and do not satisfy Chadian needs for qualify personnel to boost ICT in the country. According to the NICI plan for Chad, the need for IT specialists is estimated to be around 1500 engineers for the next five years. But the answers to this void are yet to be determined and implemented.

2. Social Status

Chad is one of the least developed countries in the world, ranking 183 (out of 187) in the 2011 UNDP human-development index. Almost all relevant indicators point to severe problems: 83% of the population lives below the poverty line of \$2 per day; in the 2010 global-hunger index, Chad ranks fourth from the bottom; the Gini coefficient of 39.8 in 2003 shows the unequal distribution of income. As oil revenues have not been directed at reducing poverty, it is expected that poverty has risen once more, but there are no data available. Poverty is primarily concentrated in rural areas, where 87% of the country's poor live.²⁰¹ Poverty in Chad has been aggravated by various conflicts during its 50 years of independence. Tensions between ethnic groups in the north and south have further contributed to political and economic instability. Moreover, Chad is subject to spillover effects from crises in neighboring Sudan and the Central African Republic.

Economic development in Chad is inhibited by its landlocked location and the desert climate in the north. The Sahelian zone (central and eastern Chad) is particularly affected by chronic food deficits. The arrival of thousands of Sudanese refugees in the area since late 2003 has put additional pressure on limited resources, placing further stress on the already highly vulnerable local population.²⁰²

²⁰¹ "BTI 2012 | Chad Country Report," The BTI Project, accessed June 25, 2012, <http://www.bti-project.org/country-reports/wca/tcd>.

²⁰² "Country Profile : Chad," World Food Program, accessed June 25, 2012, <http://www.wfp.org/countries/Chad/Overview>.

3. Access to and Acceptance of Technology

Given the harsh socioeconomic context and the underdevelopment of basic telecommunications networks, access to ICT is for now only possible in urban areas and especially in the capital towns, where there are around 12,200 Internet subscribers out of a population of 808,000.²⁰³ Cyber cafés remain the chief mode of access for the vast majority of Chadian Internet users. The estimated current Internet penetration rate in Chad is 1.8% of the population, which counts around eleven million inhabitants.

Although computer-based Internet does not exist formally in Moussoro, some residents try to use ‘Internet’ on their mobile phones. Reports indicate it is unbearably slow at peak use times, and slow at other times (this network is basically the US equivalent of Edge, not 3G). Furthermore, I found no residents who have mobile devices that rival the usefulness of an iPhone or even a Blackberry. This is a contrast to N’Djamena, which has good mobile network coverage and many residents on smartphones (I saw real, Apple-made iPhones, and Android phones are the new fad).²⁰⁴

Currently, there are 32,220 Facebook users in Chad, which makes it the number 175 over 213 in the ranking of all Facebook statistics by country. Facebook penetration in Chad is 0.31% of the country's population, and 17.16% in relation to the number of Internet users. Curiously, in the Chadian case, the total number of FB users in Chad is declining, having fallen off by 5,780 in the last 6 months. This trend demonstrates a lack of interest in social media by Chadian Internet users. The largest age group of social network users is currently 18–24 with a total of 12,244 users, followed by users between the ages of 25 –34.²⁰⁵ The Twitter database does not show any activity in Chad. However, there are a handful of people from N’Djaména who are active on Twitter.²⁰⁶

²⁰³ According to UN DATA of 2009 the density of Internet user in Chad is 1.5%, See “Country Profile: Chad,” *UNData*, accessed June 25, 2012, <http://data.un.org/CountryProfile.aspx?crName=CHAD>.

²⁰⁴ James Gibson, “Bringing computers to rural Chad (Tchad),” *OAfrica*, June 21, 2012, accessed June 26, 2012, <http://www.oafrica.com/education/bringing-computers-to-rural-chad-tchad/>.

²⁰⁵ “Chad Facebook Statistics,” *Social Bakers*, accessed June 26, 2012, <http://www.socialbakers.com/facebook-statistics/chad>.

²⁰⁶ Alwihda Info, “Tchad : « Révolution des médias sociaux: Atouts et inconvénients dans les pays des jeunes démocraties » (Débat),” *Twitter*, May 24, 2012, accessed June 26, 2012, <http://twitter.com/alwihdainfo/statuses/205733895327592449>.

Chadian civil society is still really not active in ICT. Diverse reasons explain it: absence of suitable policy on the subject, the high price of computer hardware and high cost of electricity, as well as other financial burdens (taxes and customs). The domain of ICT in Chad has not yet attracted investors, who rather prefer to bet on sectors like rural development. Initiatives for the development of ICT for this reason blocked. And other actors within civil society hesitate to dash into the adventure.

Furthermore, civil society seems to be much more attracted by the socioeconomic and political situation of the country than the question of ICT. In the media, most criticisms come are of the void in the legal framework on the use of ICT. Indeed, the absence of an appropriate legal framework does not allow for good promotion of ICT in the Chadian media. The high council on communications (HCC), the authority on regulation of communications in Chad, has proposed the revision of Law 29 (on the regime of the press). But, at the moment, no answer has been given by the executive.

All the actors in the civil society are unanimous: their needs in ICT are enormous considering the numerous difficulties they meet; these needs crystallize around access and training to ICT.²⁰⁷ Amongst the principle needs are:

- the lack of public and private structures specialized for ICT
- the limitation of the OTRT for access to the Internet via the satellite
- the high cost of taxes to companies and ceaseless cuts of electricity, which make the costs of access to ICT higher
- lack of interest from Chadian businessmen, who invest little in the field of ICT
- the difficulty of access to sources of funding for training and creation of structures focused on ICT

²⁰⁷ Dany Danzoumbe PADIRE, "Implication de la Société Civile de l'Afrique Centrale dans les Politiques des TIC : Cas du Tchad," Institut Panos Afrique de l'Ouest, accessed June 26, 2012, http://www.cipaco.org/sources/etudeSC_Tchad.pdf, 19.

4. Information Technology Dependency

As confirmed by the low level of activity in social media and the views of civil society collectively, information technology use in Chad remains very low. Although the state is engaged in a large program of development of ICT, the level of corporate use of ICTs is very low. As such, the most commonly encountered uses of ICTs are related to specific domain such as management duties (administrative and finance) and production duties. The use of the applications depends entirely on the duties of the enterprise. Overall, there is no indication of dependency on technology at all in Chad.

E. CRIMINAL ACTIVITIES

Regarding the cybersecurity picture in Chad, again nothing serious has been said on that domain. Despite of its involvement in regional collaboration, authorities still in Chad have to adopt and develop a legal framework of cyberspace. The types of cybercrime activities known in Chad, though rare, are essentially spam related.

The website ProjectHoneyPot.org, which conducts surveys of malicious activities online base on honey-pot servers generated the results presented in Table 6. These results show a very low amount of malicious activity from IP addresses within Chad's allocated range of IP addresses.²⁰⁸ They essentially revolve around spamming IP addresses.

Table 6. Honey Pot Results for Chad²⁰⁹

N°	Type of Attack	Period of activity of the 50 most recent IP	Total number of attempts registered
1	Harvester IP	July 2008 –June 2012	0
2	Spam Server IP	–June 2012	4 731
3	Bad Web host IP	–June 2012	0
4	Comment Spammer IP	–June 2012	0
5	Dictionary Attacker IP	July 2008 –June 2012	4 722
6	Rule Breaker IP	– June 2012	0
7	Search Engine IP	– June 2012	0

²⁰⁸ Project Honey Pot, "Chad : Directory Of Spam Server PIs - CHAD," *Project Honey Pot*, accessed June 26, 2012, http://www.projecthoneypot.org/list_of_ips.php?t=s&ctry=TD&by=1.

²⁰⁹ Project Honey Pot, "Chad : Directory Of Spam Server PIs."

F. CONCLUSION

Despite being Africa's latest exporter of oil, Chad has one of the least developed telecommunications markets in the world. Penetration rates in all market sectors—fixed, mobile and Internet—are well below African averages.

Considering the big challenges for development in the country, most of the actions of development during the last decades, in particular in the social, basic infrastructure, and rural development sectors, were done to the detriment of domains like ICT. As a result, administrations and companies use very little ICT; small and medium-sized enterprises are absent on the web. The public sector does not offer information and online services to citizens and economic operators. The needs of the specialized workforce hardened to ICT cannot be satisfied by training capabilities. ICTs are not introduced into the programs of education and research yet.

The telecommunications sector faces the following constraints: weakness of the legal, statutory, and institutional framework of the sector; basic infrastructures that are ruined due to the lack of investment or deliberately destroyed; nonexistence of a dynamic, competitive climate allowing the development of ICT; and weakness in the coverage of the national territory and means of access to ICT.

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APPENDIX D.

THE DEMOCRATIC REPUBLIC OF CONGO

Located in the heart of Africa, the Democratic Republic of the Congo (DRC) is the size of Eastern Europe (2.3 million square kilometers) and endowed with immense natural resources: rich forest, mineral resources, fauna, and an important hydrographic network. Since its independence in the sixties, the DRC has been plague by multiple conflicts, internal and external. This has left it in humanitarian crisis. Although the DRC has been relatively stable since the last quarter of 2002, there are still sporadic violent conflicts in the eastern part of the country. Following peace negotiations, a transitional government formed by representatives of different parties prepared the way between 2003 and 2006 for the inauguration of a democratic republic.

Since then, The DRC has undergone rapid changes in a short period of time; with 70 million people, it is one of the largest markets on the continent. In the past decade, DRC has witnessed an exponential growth of global trade and has had an impact on local economic performance. The onset of the digital age has made it natural for the DRC to transform itself into a continental telecommunication hub capable of attracting the attention of major companies in the ICT industry. Though ICT has not yet permeated every facet of the way people in DRC work, live, learn and play, the government clearly shows that it is focused and committed to do so.²¹⁰

In 2006, the Korean Agency for Digital Opportunity and Promotion (KADO) and the International Telecommunication Union (ITU) evaluated the country's digital opportunity index (DOI) to 0.08 on a scale of 0 to 1 for a rank of 176/181.²¹¹ Nevertheless, along with other efforts of nation building, the sector of information technology has seen some improvement these last five years. An increased competition in

²¹⁰ Kyamusoke Bamusulanga Nta-Bote, "ICT in the Democratic Republic of Congo," *Global-ICT*, 2007, accessed June 27, 2012, <http://www.connect-world.com/~cwiml/index.php/magazine/global-ict/item/3212-ict-in-the-democratic-republic-of-congo>.

²¹¹ The Digital Opportunity Index (DOI) evaluates the opportunity, infrastructure and utilization of Information and Communication Technologies (ICTs) worldwide, See "The Digital Opportunity Index (DOI)," *World Information Society Report 2007*, Chapter Three, ITU-UNCTAD (2007), <http://www.itu.int/ITU-D/ict/doi/material/WISR07-chapter3.pdf>, 38.

the ICT market has contributed to the rapid expansion of mobile and Internet services. Mobile penetration has reached 65 subscriptions per 100 in 2009.²¹² With only around half the population covered by a mobile signal, penetration remains below the levels of comparable sub-Saharan peers.

Table 7. Socioeconomic Indicators: Democratic Republic of the Congo²¹³

N°	Indicator	Value
1-	Area	2,344,858 square km
2-	GDP	\$25.19 billion (2011 est.)
3-	Official language	French
4-	Total population	73,599,190 (July 2012 est.)
5-	Population rate between 0-14 years	44.4% (male 16,031,347/female 15,811,818)
6-	Population 15-64 years	53% (male 18,919,942/female 19,116,204)
7-	Life expectancy	55.74 years
8-	Urbanized population	35% of total population (2010)
9-	Average annual growth rate of urban population	4.5% (2011 est.)
10-	Per capita gross national income (US dollars) GNI	675
11-	Population below \$1 a day	59.2%

A. INFRASTRUCTURES

With regard to the country size and population, the technological landscape in DRC is very limited. As a result of political instability since the mid-1990s, the national telecom system is one of the least developed in the region. Rural areas, where almost 70% of the population resides, are virtually devoid of telephone or Internet service.

²¹² Vivien Foster and Daniel Alberto Benitez, "The Democratic Republic of Congo's Infrastructure: A Continental Perspective," *AICD Country Report*, March 2010, accessed June 29, 2012, <http://www.ppiaf.org/sites/ppiaf.org/files/publication/AICD-DRC-country-report.pdf>, 8.

²¹³ "Africa: Congo, Democratic Republic of the," *The CIA World FactBook*, June 25, 2012, accessed June 28, 2012, <https://www.cia.gov/library/publications/the-world-factbook/geos/cg.html>.

The core of the network, which is essentially implemented in urban areas, consists of fixed dial-up telephone lines and HF and VHF communications for long distance links. Satellite communications devices are exclusively used for connection with the external world to permit the interconnection to international exchange hubs of phone, television, and Internet. Others forms of technologies like optical-fiber interconnection cable and very small-aperture terminals (VSAT) are very recent and remain at the development stage. For urban communication, the only technologies available are GSM, WIFI, and WIMAX. 3G and 4G technologies are very rare, but they do exist.²¹⁴

Information technologies are provided to the population through a quite a large number of operators by the regional standard. The Congolese office of post and telecommunications (OCPT), the state-owned and only legitimate telecommunications operator, theoretically has had a monopoly on the sector under 1970 legislation, and is the sole provider of landline telecommunication services. But it has been unable to provide a modern telecom network and unsuccessful in finding major investors for privatization. Due to a virtually nonexistent network of fixed phones, the DRC has turned to mobile technologies, to the extent of becoming the country with highest ratio of mobile versus fixed phone users in the world. And though the DRC has accommodated and experiment with the GSM system since 1987, it still needs more investments in the sector to expand coverage and usage.²¹⁵ Given the shortage of traditional fixed lines and recognizing the need for telecommunications infrastructure, the government is only loosely regulating the sector, thus leaving it to private operators to introduce high levels of ICT access through wireless technologies. By 2001, some 16 private operators had been granted mobile telephony licenses and the subscriber base was growing at triple-digit rates per year. The major mobile operators in the country are Zain Congo DRC (Bharti Airtel Limited), Vodacom Congo (Vodacom Group (Pty) Ltd), Congo Chine Télécoms (CCT), Tigo DRC

²¹⁴ “RD Congo: Africell, sixième opérateur de télécommunications, sur les rails,” *TIC & Telecom*, June 21, 2012, accessed June 27, 2012, <http://www.agenceecofin.com/mobile/2106-5430-rd-congo-africell-sixieme-operateur-de-telecommunications-sur-les-rails>.

²¹⁵ “Research and Markets: Democratic Republic of Congo - Telecoms, Mobile and Broadband – 2011,” March 21, 2011, accessed June 27, 2012, <http://www.fiercewireless.com/press-releases/research-and-markets-democratic-republic-congo-telecoms-mobile-and-broadban>.

(Millicom International Cellular S.A.), Standard Telecom Democratic Republic of Congo (Megapass), and Supercell, competing for a total estimated 10 million subscribers.²¹⁶

Internet services are provided to the population by seventy-five²¹⁷ operators using principally dial-up and wireless local-loop technologies for distribution, essentially WiMAX technology—but prices are still high due to the fact that DRC is still reliant on costly satellite VSAT connectivity for international Internet access.

With support from China, OCPT has started a national optical-fiber backbone rollout of 11,000 Km (estimated) and rehabilitation of fixed-line networks that will ultimately also provide access to fiber-optic submarine cables for low-cost, high-quality international bandwidth. Access to international fiber bandwidth is expected in July 2012.²¹⁸ Along with the West African Submarine Cable System (WACS), there is a project to interconnect the DRC to the neighboring capitals of the subregions (the Congo, the CAR, and Gabon) through the CAB to help diversify sources of access to the Internet. Continuing in the same perspective of diversification of access, the DRC is a member of the African satellite project, RASCOM.²¹⁹

²¹⁶ “3Q10 Democratic Republic of the Congo Mobile Operator Forecast, 2010 – 2014,” *ReportLinker*, September 2010, accessed June 27, 2012, <http://www.reportlinker.com/p0296335-summary/3Q10-Democratic-Republic-of-the-Congo-Mobile-Operator-Forecast-DR-Congo-to-have-17-8-million-mobile-subscriber-connections-in-with-Vodacom-taking-market-share-of-30.html>.

²¹⁷ “Broadband Internet Service Providers (ISP) in Congo, The Democratic Republic of the,” *Who Is This Ip*, accessed June 27, 2012, <http://www.whoisthisip.com/isp-ip-usage-country-Congo%2C+The+Democratic+Republic+of+the-limit-0.php>.

²¹⁸ “Fibre optique : la RD Congo engagée dans une course contre la montre,” *Le Phare Online*, June 18, 2012, accessed June 28, 2012, http://www.lephareonline.net/lephare/index.php?option=com_content&view=article&id=5450:fibre-optique--la-rd-congo-engagee-dans-une-course-contre-la-montre&catid=44:rokstories&Itemid=106.

²¹⁹ “Members of the RASCOM Project,” *RASCOM*, March 2005, accessed June 28, 2012, http://www.rascom.org/info_detail.php?langue_id=1&id_r=7&id_sr=0&id_gr=2.

The Democratic Republic of the Congo is the only country within the Economic Community of Central African States to possess an Internet Exchange Point (IXP). The project, which has been led since 2002 by a group of private internet services providers, had the objective of reducing the cost of Internet traffic in the country. From what one can find, this IXP project remains a private enterprise between a group of business operators, rather than a nationwide project to bridge the digital gap. It is unfortunate that there is not much data on value added by the existence of this infrastructure.

The country is endowed with the largest economically exploitable hydropower resources in Africa, giving it the potential to meet its own energy demands and become the continent's largest power exporter. Inland waterways can provide low-cost surface transport, with only relatively modest investments needed to improve navigability. Unfortunately, years of sociopolitical crisis in the DRC have seriously damaged the power infrastructure. Only a tiny fraction of the DRC's hydropower potential is developed, and much of that has fallen into disrepair. Only 2,400 MW of the 100,000 MW potential has actually been developed as installed capacity, and only 1,000 MW of this capacity is actually in functioning order. Backup generators account for half of total installed capacity. Furthermore, high international oil prices have put enormous pressure on the country, especially the region dependent on diesel and heavy fuel oil for power generation. The only part of the country's power system that is interconnected is the high-voltage transmission line running from the Inga site in Bas Congo to Katanga and on to Zambia.

As a result, the power supply is heavily constrained and subject to blackouts, placing major limitations on private activity. According to an AICD report, about 40 percent of firms in the DRC own and operate their own backup generator to shield themselves from frequent power interruptions, which cause significant production losses. This is one of the higher percentages of generator ownership in Africa. The Platt's power-generation database indicates that almost half of the installed generation capacity in the DRC is owned and operated by private companies for the purpose of self supply. Timber mills in the Kinshasa area spend up to 63 cents per kWh to run diesel-powered backup generators when needed. In the Katanga region, mining companies depend

primarily on power from the Inga hydro plant, but due to dilapidated infrastructure, supplies are highly unreliable, with 19 interruptions reported on average per month. Overall, the Katanga region is estimated to have a power supply deficit of 900 MW. Due to these deficiencies, mining companies have developed their own local hydroelectric schemes at a cost of around 10 cents per kWh. Millicom International Cellular SA reported in 2007 that 75 percent of their sites were powered by diesel-powered generators that they source, install, maintain, and refuel, which increases their cost of operations and affects profitability.²²⁰ Furthermore, the weak financial performance of the power utility, Société Nationale d'Electricité (SNEL), has led to a hemorrhage of resources in the sector. According to the AICD country report on DRC, "the SNEL displays very high levels of inefficiency, compared with other African power utilities, though its performance is typical for fragile states."²²¹ One of the DRC's most urgent infrastructure challenges is to increase the generation of power and deliver it in a more cost-effective manner. The same report concludes that in order to meet domestic demand, DRC power capacity must be increased by 35 percent by 2015. Providing reliable public supplies could reduce the price of power to the urban private sector from 23 cents to 4 cents per kilowatt-hour.

The Democratic Republic of the Congo has no ICT industrial facilities; all the ICT equipments are imported, including access equipment (radio and television sets, computers, telephones) as well as routine maintenance equipment. Thus, the country is totally dependent on imports, as far as the acquisition of equipment and software for ICT development are concerned. However, there are some companies that provide industrial services such as the construction and exploitation of mobile-telecommunication towers.²²²

²²⁰ Mark D. J. Williams, Rebecca Mayer, and Michael Minges, "Africa's ICT Infrastructure: Building on the Mobile Revolution," *The World Bank*, Washington DC, 2011, accessed June 29, 2012, www.worldbank.org, 67.

²²¹ Vivien Foster and Daniel Alberto Benitez, "The Democratic Republic of Congo's Infrastructure: A Continental Perspective," *AICD Country Report*, March 2010, accessed June 29, 2012, <http://www.ppiaf.org/sites/ppiaf.org/files/publication/AICD-DRC-country-report.pdf>, 8.

²²² "Why mobile telecom towers are big business in Africa," *Maritz Publishing*, June 12, 2012, accessed June 29, 2012, <http://www.howwemadeitinafrica.com/why-mobile-telecom-towers-are-big-business-in-africa/17421/>.

B. INFORMATION SYSTEMS, BUSINESS, AND INDUSTRIES

Apart from proprietary systems for telecommunication infrastructures, the bold majority of OSs in use in the DRC are Windows based. The services offered in DRC cyberspace are exclusively web hosting, communications (VOIP, SMS, e-mail), and web navigation.

The country has been often associated with risks such as unstable political environments, unpredictable economic performance, and lack of financing and skilled staff. In recent years, there has been political determination to address these perceptions. And as a result, the government nourishes the hope that companies like Cisco, Motorola, Alcatel Lucent, ZTE, Nokia, and others will open offices in the Democratic Republic of the Congo.

In DRC, the banking system is reputed to be very poor; around 20,000 active bank accounts were available in 2005. This situation has opened the way to mobile banking. Companies like South African CELPAY provide a comprehensive mobile banking service between users, including the ability to make payments in real time using GSM airtime recharge.²²³

Software engineering companies and IT engineering providers (networks and applications), though they exist, are very few in the DRC and are organized in the form of small and medium enterprises (SME). Among the notable are BSCERCTOOL, BERISASOFT, CGLM, and GROUJIC (an association of young software engineers with the aim of creating a business startup). In the rural areas, these SMEs work with NGOs to offer some IT services that fit the needs of the population for their daily task.

In the public sector, the DRC is ranked 174/190 on the index of electronic government by the United Nation.²²⁴ Currently, several projects for implementation of networks and computerization are introduced by diverse government administrations, but

²²³ Sam Moss, "FirstRand Expands Further In Africa," *First Rand*, March 30, 2005, June 29, 2012, <http://www.firstrand.co.za/content/291/firstrand-expands-further-in-africa/>.

²²⁴ "E-Government Survey 2012," *United Nation*, New York (2012), accessed June 29, 2012, <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan048065.pdf>, 144.

with a lack of coordination, each of them is realized independently. The construction of a governmental intranet in optical fiber with the cooperation of the Korean government is underway. In 2008, four institutions were connected to the office of the presidency: the prime minister's office, the ministry of public service, the ministry of foreign affairs, and the ministry of international cooperation. In 2009, six other ministries joined the network: the ministries of plans, finances, budget, justice, infrastructures, public works and reconstruction, and posts, telephones, and telecommunications. The connection of the rest of the government was scheduled by 2010. However, most government services are still paper-based in DRC. The government agency that oversees government construction projects still uses almost exclusively drawing papers and brushes to design projects. Record keeping is a challenge in almost every sector.

C. LAWS, REGULATIONS, AND ORGANIZATION

1. Strategies and Policies

In a speech giving by the Congolese minister of telecommunications in 2007 at the ITU conference, the DRC government made it clear that it has “made a conscious effort and commitment to give key stakeholders, the people, public, and private sectors the opportunity as a government to contribute with their ideas and hence share in the creation of Congo’s telecommunications and digital future.”²²⁵ He continued by saying, “We support, and will continue to support, all ICT companies planning to do business in the DRC market.” Although there is a clearly expressed will to develop the ICT sector in the DRC, the legislative framework remain very poor.

In 2004, the DRC teamed up with the United Nations Economic Commission for Africa (UNECA) to develop a national information and communication infrastructure (NICI) plan. But due to political unrest in the country, the process was stalled for several

²²⁵ Kyamusoke Bamusulanga Nta-Bote, “ICT in the Democratic Republic of Congo,” *Global-ICT*, 2007, accessed June 27, 2012, <http://www.connect-world.com/~cwiml/index.php/magazine/global-ict/item/3212-ict-in-the-democratic-republic-of-congo>.

years.²²⁶ With the normalization of the political arena since 2007, the NICI process has restarted; and so far, the plan has achieved significant results in terms of e-government and national backbone infrastructure. However, a lot still have to be done, especially on the legal framework.

The more comprehensive initiative is the collaboration between government, civil society, media, and private sectors for an innovative approach and a multi-stakeholder alliance on ICT for development policy. This is known as the multi sector ICT dynamic (DMTIC), with the objective of democratizing access to ICTs in the DRC and transforming them into a real tool of empowerment and social development. The DMTIC was formed as a non-profit-making organization after a multi-stakeholder roundtable organized in January 2005 in Kinshasa.

2. Laws, Regulations, and Organization

The legal and regulatory framework for the telecommunications sector remains rudimentary. The legal framework governing the sector was enacted in 2002. It defines a model of markets where a public operator develops a network of infrastructures, supplying to the other operators (private/public) the interconnection and capacities of national and international transmission. Unfortunately, the implementation of this legal framework collides with the absence of certain texts ruling the operational deployment, texts which are still in a state of project, particularly the texts defining the management and control of the electromagnetic spectrum.

Four institutions are responsible for ICT management in the DRC: the ministries of posts and telecommunications and of press and information; the high authority on media (HAM), and the posts and telecommunications regulatory authority (ARPTC). They have often been in conflict or tangled in power struggles because legislation does not clearly express their respective responsibilities.²²⁷ ICTs are under the mandate of the

²²⁶ “NICI Country Page: Democratic Republic of Congo,” *Economic Commission for Africa (ECA)*, 2006, accessed June 29, 2012, <http://www.uneca.org/aisi/nici/drc/drc.htm>.

²²⁷ Mwepu, J., *Implication de la Societe Civile de l’Afrique Centrale dans les politiques TIC : Cas de la République Démocratique du Congo*. The Panos Institute-West Africa (2006), 15.

ministry of posts and telecommunications. The Congolese office of posts and telecommunications (OCPT) also falls under the authority of the ministry. However, the regulating agency, the ARPTC, falls under the authority of the president. The ministry of press and information is responsible for services and institutions relating to the audiovisual sector. Under its jurisdiction is the public media regulator, HAM, which was created as an institution to strengthen democracy for the duration of the transitional government. It will be replaced by an audiovisual and communications high council (CSAC), as stated in Article 212 of the Congolese constitution.

There is no evidence of a legal framework to address cybersecurity issues or crimes in cyberspace. Neither are legal aspects of e-commerce has yet been developed.

D. INFORMATION TECHNOLOGY IN THE SOCIETY AND CULTURE

1. Education

In most elementary schools, secondary schools, and colleges across the country, education is not supported by ICT systems, except in very few private and public institutions. Where ICT exists, it is marred by several challenges, including lack of stable electricity and adequate facilities, unavailability of qualified educators, problems in retention of qualified educators, especially in rural areas, and lack of security for schools and equipment, and more.

Due to the sociopolitical context of the last three decades, different governments of the DRC have been spending less money throughout the years on education. The educational system is essentially funded by parents. The rate of schooling is 52% and the general illiteracy rate in 2011 was very high at 32.7%, and even greater among women, at 45.9%. Primary schooling has diminished, due to the isolation of the region, the limited revenue of parents to pay school fees, the lack of infrastructure and school materials, and the poor quality of instruction. The duration of compulsory education is six years for children between six and 12 years of age. Although children are expected to spend three years in pre-school, this rarely happens, except in some urban zones. Primary school is divided into three cycles of two years per cycle. Secondary education consists of one long

cycle and a short cycle. The long cycle has a general, a standard, and a technical field. The short cycle concerns professional education and consists of four years of training, beginning immediately after primary education, or three years of training after the common studies in secondary school.

There are also engineering schools that offer training in craftwork for three to four years. Higher education is composed of a first cycle of three years and a second of two to three years, depending on the field of study. Three types of higher education are organized in the Democratic Republic of Congo: university education, advanced teacher training, and advanced technical training. The third cycle offers the degree of advanced studies (DES) and the doctorate.

The DRC's education system is out of date and doesn't meet people's needs. Based on the Belgium system since independence in 1960s, its contents are unreformed. Actually, the economic structure has completely changed: more than 70% of the economy is informal. Since there is a lack of formal jobs, university graduates are unemployed or underemployed in the informal sector, so that there is a misallocation of resources inside the economy.²²⁸

A national policy on ICT use in education was launched in 2004, within which two main priorities were identified: the Internet network and electronic governance. These priorities are reflected in action at the university, basic education, and community levels.

At the university level, the following initiatives were taken:

The Virtual Francophone Campus works to unite higher-education institutions through the organization of distance-training sessions and the facilitation of research in the fields of science and technology.

Education For Change (EFC) consultants have been engaged by Vlaamse Interuniversitaire Road University Development Cooperation (VLIR-UOS) and Conseil

²²⁸ Christian Otchia Samen, "Education in the Democratic Republic of Congo : Challenges and tentatives solutions," *The WordPress*, July 7, 2010, accessed June 30, 2012, <http://otchia.wordpress.com/2010/07/07/education-in-the-democratic-republic-of-congo-challenges-and-tentatives-solutions/>.

Interuniversitaire de la Communauté française de Belgique—Commission Universitaire pour le développement (CIUF-CUD) in Belgium to identify needs and opportunities to strengthen ICT capacity in the DRC through a transversal program involving seven universities. This will draw on lessons from the experience and results of existing and ongoing work at the universities of Kinshasa (UNIKIN) and Lubumbashi (UNILU). The work also seeks to facilitate networking among a variety of teaching and research programs.²²⁹

The University of Kinshasa and a group of dedicated teachers enacted a program to interconnect all Congolese universities. Using an optical-fiber backbone, their project now serves 10 UNIKIN establishments. It aims to prevent the continued departure of university specialists and meet the growing demand for distance-training programs. The project was made possible by a grant from Belgium.

The linking of the universities of Kinshasa and Lubumbashi to reliable VSAT connections through a VLIR-funded (Free University of Brussels/Belgium) project has opened the doors to new research opportunities for both universities. However, the cost of such a link remains expensive—Kinshasa and Lubumbashi are separated by a distance of approximately 1,600 kilometers. Contacts have been made recently with the African Virtual University (AVU) to find ways of decreasing costs.

The Polytechnic faculty serves as the regional platform for the Cisco Academy and provides hosting for students from Congo Brazzaville, the DRC, and other surrounding countries.

In terms of major initiatives to welcome more people into the Information Age, ICT training seems particularly dynamic. For example, some primary schools are making an effort to orient their students towards computer technology at an early age. There are several private training centers in the capital that offer short courses on network management and developing web servers and online databases. In this model, there is a real market in technology training to meet a high demand.

²²⁹ “ICT programme in and for universities in the Democratic Republic of Congo (DRC),” *Education For Change*, March 2, 2007, accessed June 30, 2012, <http://www.efc.co.uk/news/article.jsp?id=15>.

The Virtual African University (UVA) and the Francophone Academic Agency (AUF) have set up the Virtual Francophone University (UVF).²³⁰ This allows its users to share academic resources formulated in French using a network established by the partnership.

As of early 2005, the African Centre of Cultural Exchange (CAFEC) worked in close collaboration with some Congolese organizations (ASSIC, JUSDATA, etc.) to set up a Congolese action for the popularization of ICT. This has won the support of Alternatives, a Canadian NGO settled in the DRC. CAFEC also managed to create the National Network of Congolese NGOs for the Promotion of ICT (REPRONTIC), which currently involves 23 Congolese NGOs and is a source of much interest from PNUD/DRC.²³¹

As a key instrument in the French cooperation policy for digital gap reduction, ADEN has implemented digital inclusion programs in 11 sub-Saharan French, English, and Portuguese-speaking countries. Provided with a substantive budget, it has three goals: democratizing access to ICT; training local populations; and supporting Internet uses, contents, and applications for development. Multiple centers have been founded in the country.²³² These centers are resources for the masses eager to access the Internet, but constant problems are experienced, such as poor electrical-power provision, low attendance due to the population base's being away from the centers, and faulty computer materials and accessories.

The International Education and Resource Network (iEARN), a nonprofit organization empowering teachers and young people to use the Internet to work together online on collaborative projects, is based in Kinshasa-Limete in the Democratic Republic

²³⁰ “The African Virtual University receives a grant of USD15.6 million from the African Development Bank Group to help increase ICT in education support to African countries,” *African Virtual University*, January 24, 2012, accessed June 30, 2012, <http://www.avu.org/News/the-african-virtual-university-receives-a-grant-of-usd156-million-from-the-african-development-bank-group-to-help-increase-ict-in-education-support-to-african-countries.html>.

²³¹ Babacar Fall, “ICT in Education in the Republic of Congo (Congo-Brazzaville),” *infoDev*, June 2007, accessed June 30, 2012, <http://ddp-ext.worldbank.org/EdStats/COGpro07.pdf>, 7.

²³² “ADEN project: Appui au désenclavement numérique,” accessed June 30, 2012, http://euroafrica-ict.org.sigma-orionis.com/downloads/Awareness_Workshops/Nigeria/Alexandre_Foulon.pdf, 2.

of the Congo.²³³ Despite the lack of Internet access in the country, students and teachers can benefit from the iEARN network, which enables them to learn how to use computers.

Although ICT education in the public schools still seems to be in its infancy in the DRC, the recently published *Development Strategy for Primary, Secondary and Professional Education (2010/11 – 2015/16)* recognizes the need to use ICT to contribute to capacity building and increase teachers' capabilities.²³⁴ The curriculum for computer education in secondary schools envisions that every student should be able to use the Internet for web browsing and e-mailing by the end of the second year, and aims to teach students how to implement available security measures such as password protection and antivirus software to protect their computer.²³⁵

2. Social Status

The 2011 *UNDP Human Development Report* ranks DRC at the bottom of its human-development index (187th out of 187 countries). Despite recent progress, the Democratic Republic of the Congo still suffers from inadequate incomes, limited schooling opportunities, and life expectancies far below world averages, due in great part to deaths from preventable and treatable diseases such as malaria and AIDS. These problems are compounded by the destructive legacy of armed conflict. In the DRC, more than three million people died from warfare and conflict-linked illness in recent years, prompting the largest peacekeeping operation in UN history.²³⁶

²³³ "Democratic Republic of the Congo," *IEARN*, accessed June 30, 2012, <http://congo.iearn.org/>.

²³⁴ The Democratic Republic of Congo, "STRATEGIE DE DEVELOPPEMENT DE L'ENSEIGNEMENT PRIMAIRE, SECONDAIRE ET PROFESSIONNEL (2010/11 - 2015/16)," *Ministry of Education*, March 2010, accessed June 30, 2012, <http://planipolis.iiep.unesco.org/upload/Congo%20DR/CongoDRStrategie20102016.pdf>, 8-14.

²³⁵ The Democratic Republic of Congo, "PROGRAMME D'INFORMATIQUE DE L'ENSEIGNEMENT SECONDAIRE," *Ministère de l'Enseignement Primaire Secondaire et Professionnel*, March 2010, accessed June 30, 2012, http://www.epsp.cd/component/option,com_joomdoc/Itemid,84/gid,31/task,doc_download/.

²³⁶ "2011 Human Development Index covers record 187 countries and territories, puts Norway at top, DR Congo last," *NUDP*, November 2, 2011, accessed June 30, 2012, <http://hdr.undp.org/en/media/PR2-HDI-2011HDR-English.pdf>, 2.

Gross domestic product (GDP) growth slowed in 2011 in the Democratic Republic of Congo to 6.5% as a result of global inflationary trends and a highly charged political atmosphere inside the country, and is expected to fall to 5.1% in 2012 before picking up again to 6% in 2013. The country faces a major challenge in youth employment. More than 70% of those aged 15 to 24 have no jobs, with urban areas particularly affected. The DRC does not have a real policy to put young people to work. The shortage of jobs helps increase the size of the informal sector and the weakness of supportive structures leads many young people into a life of crime.

3. Access and Acceptance of Technology

The penetration of ICT is small. For example, the proportion of households having a computer was, in 2007, 0.3% (against 10.1 in Cameroon, 5.0 in Congo Brazzaville, and 4.3 in the Gabon) and households having access to the Internet of 0.2% (against respectively 5.2, 1.4, and 3.6 in the countries above).

For now, wireless technology seems to provide the best hope to bridge the digital divide. This has been demonstrated by the imaginative use of GSM phones. The development of services such as mobile broadband and WiMAX offers scalable solutions for real access to low-income communities and developed communities in sparsely settled areas.

Thanks to the economies of scale generated by the vast global market, the cost of buying and using a mobile phone is falling steadily and mobile penetration is rising rapidly in the country. There is, nevertheless, still much to do to improve the affordability of telecommunications. Some of the Congolese regard mobile phones and broadband Internet as luxuries rather than essential communication tools. In large cities, the Congolese have access to the Internet in cybercafés, mainly to read and send e-mails. More and more young people go to cafes to use social networks, but the very slow connection speed generally prevents video playback.

Currently, there are 807,560 Facebook users in the Democratic Republic of Congo, which makes it number 87 over 213 in the ranking of all Facebook statistics by country. Facebook penetration in the DRC is 1.14% of the country's population, and

221.25% in relation to number of Internet users. This number, though already low with regard to the size of the population, has been decreasing during the past six months, showing a lack of interest in social media by the population. The largest age group of social network users is currently 18–24, with a total of 298,797 users, followed those aged 25–34.²³⁷ The Twitter database does not show any activity coming from the DRC, although there are some Twitters accounts captioning topics on the DRC, those accounts are usually operated by people outside the DRC, either for political activism or commercial purposes.²³⁸

Internet happenings in the DRC are hard to come by. For one, few independent news sources exist in the region. Those who do exist often cover human rights or politics. However, a few bloggers from the DRC keep the world informed of ICT developments in Kinshasa. Various NGOs and aid organizations provide disaster news.

4. Information Technology Dependency

The level of corporate use of ICTs is very low. As such, the most commonly encountered uses of ICTs are related to specific domains such as management (administrative and finance) and production duties. The use of the applications depends entirely on the duties of the enterprise. Enterprises with Internet connectivity, though rare, quite often are involved with e-transactions, like mailing and online research activities. Overall, there is no indication of dependency on technology at all in the DRC society. ICTs are still considered a luxury rather than a daily tool for life.

E. CRIMINAL ACTIVITIES

Regarding the cybersecurity picture in the Democratic Republic of the Congo, as always, nothing serious has been said or exists on that domain. At the level of development of ICT in the country, cybersecurity issues are not considered a problem. The problem of developing access and utilization of technologies outweighs security

²³⁷ “Democratic Republic of Congo Facebook Statistics,” *Social Bakers*, August 3, 2012, accessed July 10, 2012, <http://www.socialbakers.com/facebook-statistics/democratic-republic-of-congo>.

²³⁸ “Crisis In The Congo,” *Twitter*, accessed July 11, 2012, <http://twitter.com/congocrisis>.

issues. In the absence of a clearly define legal framework for ICT, it is premature to look for specific laws or regulations regarding cyber crimes in particular. Allegedly, as part of a global effort tied to the e-government endeavor, the country is preparing a set of laws that will set the basis of all cyber activities.

Overall, in the Democratic Republic of the Congo, cybercrime activities are either rare or not documented, leading to a void of reliable information.

The website ProjectHoneyPot.org which conducts surveys of malicious activities online based on honey-pot servers, generated the results presented in Table 8. These results show a very low amount of malicious activity from IP addresses within the Democratic Republic of the Congo's allocated range of IP addresses.²³⁹ The little activity registered revolve essentially revolving around spamming.

Table 8. Honey Pot Results for the Democratic Republic of the Congo²⁴⁰

N°	Type of Attack	Period of activity of the 50 most recent IP	Total number of attempts registered
1	Harvester IP	–June 2012	1
2	Spam Server IP	December 2005 –June 2012	56 212
3	Bad Web host IP	–June 2012	0
4	Comment Spammer IP	–June 2012	6 142
5	Dictionary Attacker IP	December 2005 –June 2012	56 212
6	Rule Breaker IP	– June 2012	0
7	Search Engine IP	– June 2012	0

²³⁹ “Democratic Republic of the Congo: Directory of Spam Server Ips,” *Honey Pot Project*, accessed July 13, 2012, http://www.projecthoneypot.org/list_of_ips.php?ctry=CD&t=s.

²⁴⁰ “Democratic Republic of the Congo: Directory of Spam Server Ips,” *Honey Pot Project*, accessed July 13, 2012, http://www.projecthoneypot.org/list_of_ips.php?ctry=CD&t=s.

F. CONCLUSION

In spite of its limited development at present, the prospects are promising with regard to the intentions of investment announced by big operators of telephony and the final connection of the country to the optical fiber.²⁴¹

²⁴¹ “International bandwidth finally on the horizon for DR Congo,” *OAfrica*, July 11, 2012, accessed July 11, 2012, <http://www.oafrica.com/broadband/international-bandwidth-finally-on-the-horizon-for-dr-congo/>.

APPENDIX E.

THE REPUBLIC OF EQUATORIAL GUINEA

The Republic of Equatorial Guinea is a country located in central West Africa bordering the Bight of Biafra between Cameroon and Gabon; it shares maritime borders with Nigeria and São Tomé and Príncipe. With an area of 28,000 km², it is one of the smallest United Nations members from continental Africa, having a population estimated at half a million, of which 67% live in rural areas. It comprises two parts: a continental region (Río Muni), including several small offshore islands like Corisco, Elobey Grande and Elobey Chico, and an insular region, containing Annobón island and Bioko island, where the capital Malabo is situated. It is one of the few territories in mainland Africa where Spanish is an official language, besides the Spanish exclaves of Ceuta and Melilla.

The discovery of sizeable deposits of oil and gas in the 1990s has altered the economic and political status of the country. Equatorial Guinea was suddenly transformed into one of Africa's fastest growing economies and one of the main destinations of foreign investment on the continent. In 2007, Equatorial Guinea's GDP was 60 times larger than in 1995. In 2007, oil and gas accounted for an estimated 91% of GDP, 91% of government revenue, and 99% of exports. Increasing oil production has allowed the government to follow an expansionary fiscal policy: public spending increased by an estimated average of 44% per year since 2003. Though its soil is oil and mineral rich, Equatorial Guinea is classified at 136 over 187 on the UNDP Human Development Index of 2011,²⁴² showing that the oil revenues have not yet been distributed in all levels of society.

In 2006, the International Telecommunication Union (ITU) evaluated the country's digital opportunity index (DOI) to 0.27 in a scale of 0 to 1, for a rank of 131/181.²⁴³ However, the country is engaged in the process of developing ICT access

²⁴² "Regional and National Trends in the Human Development Index 1980-2011," *UNDP Report*, 2011, accessed July 12, 2012, <http://hdr.undp.org/en/data/trends/>.

²⁴³ "The Digital Opportunity Index (DOI)," *World Information Society Report 2007*, Chapter Three, ITU-UNCTAD (2007), <http://www.itu.int/ITU-D/ict/doi/material/WISR07-chapter3.pdf>, 38.

nationwide. The following indicators show the status of these efforts: the penetration rate of telephony services is estimate to be 72% of the population, with a landline teledensity of 2% and mobile teledensity of 70% in 2009. The Internet penetration rate is estimate to be around 3% of the population.²⁴⁴

Table 9. Socioeconomic Indicators: Equatorial Guinea²⁴⁵

Nº	Indicator	Value
1-	Area	28,051 sq km
2-	GDP	\$26.11 billion (2011 est.)
3-	Official languages	Spanish (official) 67.6%, French (official) and others 32.4%
4-	Total population	685,991 (July 2011 est.)
5-	Population rate between 0-14 years	41.5% (male 140,946/female 136,294)
6-	Population rate between 15-64 years	54.4% (male 179,141/female 184,358)
7-	Life expectancy	62.75 years
8-	Urbanized population	40% of total population (2010)
9-	Average annual growth rate of urban population	3.1% annual rate of change (2010-15 est.)
10-	Per capita gross national income (US dollars) GNI	\$ 37,990 ²⁴⁶
11-	Population below \$1 a day	60% ²⁴⁷

²⁴⁴ “Country Profile: Equatorial Guinea,” *The CIA World FactBook*, June 20, 2012, accessed July 12, 2012, <https://www.cia.gov/library/publications/the-world-factbook/geos/ek.html>.

²⁴⁵ “Country Profile: Equatorial Guinea,” *The CIA World FactBook*, June 20, 2012, accessed July 12, 2012, <https://www.cia.gov/library/publications/the-world-factbook/geos/ek.html>.

²⁴⁶ “GNI per capita, Atlas method (current US\$),” *The World Bank Group*, June 20, 2012, accessed July 12, 2012, http://devdata.worldbank.org/ict/gnq_ict.pdf, 15.

²⁴⁷ “Equatorial Guinea Rights and Liberties Report,” *Africa.com*, accessed July 12, 2012, <http://www.africa.com/equatorial-guinea/report>.

A. INFRASTRUCTURES

Its small size and the recently discovered oil reserves have given to the country tremendous advantages and opportunities to rapidly overcome the digital gap. Thus, telecommunications have improved dramatically in recent years. The Guinea Ecuatorial Comunicaciones Sociedad Anonima (GECOMSA), a joint venture between the state (51% of the stakes) and the China (which owns a 49% stake), provides telephone service in the major cities through an efficient, digital, fixed network and good mobile coverage.²⁴⁸ Although less than 2% of the population has a fixed-line connection, mobile telecoms grew at an average rate of 80% since year 2000, and by 2007 almost one half of the population was using mobile phones. This rapid growth has caused periodic disruptions to services, as the telecoms infrastructure has not expanded at the same speed. As a result, the government decided to increase competition in the sector and awarded a second mobile-phone license to Saudi Arabia's HIST Telecom in 2008.²⁴⁹

Satellites solutions remain and are commonly used for ICT access in remote areas. Meanwhile, urban communications are dominated by technologies like ADSL, GSM, 3G, WIFI, and WIMAX.

Internet access remains limited, although Internet cafés have spread to all major urban centers. Internet Services are provided to the population by nearly 14²⁵⁰ operators, using various technologies from dial-up to VSAT via wireless local-loop systems.

Equatorial Guinea's ministry of transport, technology, posts, and telecommunications is working to deploy advanced telecommunications services, including phone and Internet, throughout the entire country as part of the goals set forth

²⁴⁸ "Gecomsa launches operations in Equatorial Guinea," *UIT Telecommunication - ICT Statistics Newslog*, January 27, 2012, accessed July 12, 2012, <http://www.itu.int/ITU-D/ict/newslog/Gecomsa+Launches+Operations+In+Equatorial+Guinea.aspx>.

²⁴⁹ "Hits secures national telecom licence in Equatorial Guinea," *Telecompaper*, March 24, 2008, accessed July 12, 2012, <http://www.telecompaper.com/news/hits-secures-national-telecom-licence-in-equatorial-guinea>.

²⁵⁰ "Broadband Internet Service Providers (ISP) in Equatorial Guinea," *Who Is This*, accessed July 12, 2012, <http://www.whoisthisip.com/isp-ip-usage-country-Equatorial%20Guinea.php>.

by the government in the Horizon 2020 plan.²⁵¹ Various projects are already underway, including the deployment of a fiber-optic submarine cable between the mainland and island region, as well as the development of a backbone network for the entire nation. In addition to the fiber-optic cable project, Equatorial Guinea is participating in a project supported by France Telecom and 14 African operators known as ACE (African Coast to Europe), which will extend another fiber-optic cable starting in France to link Europe to Africa. The project, promoted by France Telecom Orange, will feature a 17,000 km cable and is expected to be operational as early as 2012. It will connect more than 23 countries.²⁵² Additionally, with the countries of the Central African region, Equatorial Guinea is scheduled to be connected to the CAB during the second phase of the project, which aims to interconnect all the capitals of the subregion.²⁵³ Equatorial Guinea is also a member of the African telecommunications-satellite initiative, RASCOM, scheduled to reduce the cost of international communication and data transmission.

Equatorial Guinea does not possess, or plan to possess, an Internet Exchange Point (IXP), but as a member of the CAB project, the IXP that is planned for Phase II of the project will be shared by the three countries in the alliance.²⁵⁴

Equatorial Guinea is estimated to have 2,600 MW of hydropower potential. But the estimation of its power-generating capacity varies, with 15.4 megawatts (MW) of certain installed capacity and 5-30 MW of estimated additional capacity. Generating capacity is made up of thermal generation (80%) and hydroelectric generation (20%). About 5.0 MW are located on the mainland, including 4 MW of oil-fired thermal capacity

²⁵¹ "Equatorial Guinea Connects to the Future With New Telecommunications Projects," *PRNewswire-USNewswire*, July 30, 2010, accessed July 12, 2012, <http://www.prnewswire.com/news-releases/equatorial-guinea-connects-to-the-future-with-new-telecommunications-projects-99628819.html>.

²⁵² "Equatorial Guinea Minister discusses telecommunications advances," *EquatorialGuineaNews*, Jul 29, 2010, accessed July 12, 2012, http://www.youtube.com/watch?v=zTutYbgoWR0&lr=1&uid=w-fAmKLbw6kNshkn2_iTcg.

²⁵³ "Cable: Cameroon will interconnect the 10 regional capitals in less than one year (General Paper)," *Emploi Service*, August 10, 2012, accessed July 12, 2012, http://www.emploiservice.net/index.php?option=com_content&view=article&id=254&lang=en&limitstart=20.

²⁵⁴ "Central African Backbone Project - APL1A in Chad: Harmonization and Modernization of the Legal and Regulatory Framework for Electronic Communications," *World Bank – WB DEVEX*, July 28, 2010, accessed June 22, 2012, <http://www.devex.com/en/projects/central-african-backbone-project-apl1a-in-chad-harmonization-and-modernization-of-the-legal-and-regulatory-framework-for-electronic-communications>.

and 1 MW of hydroelectric capacity. Bioko Island receives electricity from two thermal plants and one hydroelectric plant. The expansion of natural- gas production at the Alba field in recent years has provided a convenient fuel source for new power generation in the country. The 10.4MW, natural gas-fired Punta Europa plant began operation in 1999, supplying gas-fired electricity to Bioko Island. Another 4-6 MW of generation capacity is currently under construction at the AMPCO complex on the island.

Equatorial Guinea's electricity sector is owned and operated by the state-run monopoly, SEGESA. Like other countries in the region, the power supply is unreliable, due to aging equipment and poor management, as demonstrated by regular blackouts in Malabo. As a result, small diesel generators are widely used as a backup power supply. Nevertheless, some improvements can be expected as the government contemplates the liberalization of energy sector.

Equatorial Guinea has no ICT industrial facilities. All equipment is imported, from access equipment (radio and television sets, computers, telephones) to routine-maintenance equipment.

B. INFORMATION SYSTEMS, BUSINESS, AND INDUSTRIES

The ICT infrastructure in Equatorial Guinea operates in standard and basic way. As usual, industrial infrastructures use proprietary OSs and their types are likely tied to the companies' internal policies. But at the level of the end user, the most commonly used systems are Microsoft Windows based. There is not much sign of the use of Open Source OS.

The services offered in cyberspace revolve around web hosting, communications (VOIP, SMS, e-mail), and web navigation. Electronic commerce is yet to be introduced. Some few small and medium enterprises (SME) marketing ICT products and services exist and are based mainly in Malabo and Bata, the two major cities. Most of them are local branches of foreign firms or have concluded local-representation agreements with such firms (for software and networking solutions and IT security).

In the public sector, Equatorial Guinea is ranked 151/190 (thus regressing 13 steps since 2010) on the index of electronic government by the United Nation in his 2012 survey,²⁵⁵ showing a slowdown in the effort done to use information technology in the government. There is no evidence of interconnection project between different entities of the government or the development of information systems in order to ease the quality of services in the public administration.

Overall, the ICT activity in this country is closely tied to the oil industry, and the initiatives are private to these companies for the purpose of their operations with the external world.

C. LAWS, REGULATIONS, AND ORGANIZATION

1. Strategies and Policies

The country is not officially known to possess a NICI plan, but information exists about the preparation of such a plan. Although a strategic plan for ICT does not exist, the government of Equatorial Guinea has made clear its ambitions to develop and promote ICT in the country. In his development strategy for horizon 2020, the ICT sector is clearly cited as a priority.²⁵⁶

2. Laws, Regulations, and Organization

The legal and regulatory framework for the telecommunications sector in Equatorial Guinea is still rudimentary. In November 2005, the first telecommunications act, Act No. 7/2005 (the General Telecommunications Act) was promulgated, opening up the telecommunications market in the Republic of Equatorial Guinea and putting an end to the monopoly that had previously governed the sector. This telecommunication act allowed the creation and the implementation of a ministry of transport, technology, posts

²⁵⁵ “E-Government Survey 2012,” *United Nation*, New York (2012), accessed June 29, <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan048065.pdf>, 34.

²⁵⁶ “Equatorial Guinea Connects to the Future With New Telecommunications Projects,” *PRNewswire-USNewswire*, July 30, 2010, accessed July 12, 2012, <http://www.prnewswire.com/news-releases/equatorial-guinea-connects-to-the-future-with-new-telecommunications-projects-99628819.html>.

and telecommunications, and a regulatory agency for telecommunications (ORTEL). This later entity was charged with the responsibility of legislating and regulating the sector with views towards effective establishment of competition and consistency in the telecommunications market.²⁵⁷

Equatorial Guinea is member of several international organizations, one of which is the ITU. At the regional level, it is active in the work of the Economic Community of Central African States (ECCAS) in the area of telecommunications and has participated in the region's efforts to harmonize the legal framework for telecommunications.²⁵⁸

Overall, the legal framework of ICT in Equatorial Guinea is characterized by the existence of numerous gaps in the telecommunications act. Indeed, the Equatoguinean Act ignores numerous activities that have developed in the ICT sector worldwide. The concept of new information technologies and communication and the Internet does not appear in the act on telecommunications. Also, legislation is silent on the repression of breaches committed by means of information technologies and communication.

D. INFORMATION TECHNOLOGY IN THE SOCIETY AND CULTURE

1. Education

At independence, Equatorial Guinea inherited a relatively good educational system from the Spanish, but it deteriorated quickly by years of mismanagement. In the 1980s educational enrollment improved again, and the net enrollment rate has been close to 90% since the beginning of the 1990s. Although the country's 87% overall literacy rate is significantly above the 63% average for sub-Saharan Africa, major gender inequalities

²⁵⁷ Rufino-OVONO ONDO ENGONGA, "Seminar Contributions," *ITU*, November 10, 2009, accessed July 2012, http://www.itu.int/ITU-D/treg/Events/Seminars/GSR/GSR09/consultation_contributions/Equatorial_Guinea_E.pdf.

²⁵⁸ "El Secretario de Estado de Transportes, Tecnologías, Correos y Telecomunicaciones en la reunión especial de la CEEAC," *Secretaría de Estado para Tecnología y Telecomunicaciones*, April 26, 2010, accessed July 13, 2012, <http://www.guineaecuatorialpress.com/noticia.php?id=500>.

persist. Human resources and skills are not well developed, partly because the share of budget resources devoted to the education sector continues to be very small.^{259, 260}

In the absence of a national strategy for ICT development, it is logical that Equatorial Guinea remain vague on its educational policy toward new technologies. As the research seems to confirm, there is not much being said on developing ICT training capabilities. At the discharge of the country, the Law of Education, Section 6, Article 46, opened a windows for distance training, stating that “Distance education is one of the educational tools that makes it possible to pursue and/or continue educational studies in any circumstance.” But this provision remains to be fully developed.

However, the needs for skills in ICT have pushed forward some private and NGO initiatives for training and education. Among the initiatives worth noting are:

- The Prepaly initiative, enacted on a platform called “Prépaly” (interactive multimedia training for PREParing high school students (LYcéens) in advanced scientific and technological studies), with the aim to respond to the needs of young people in terms of information in science and technology; give them basic training in computers and multimedia that will be their key to a successful academic career and help prepare them for the world outside of school; reinforce the ties between secondary and higher schools in the north with those in the south and reinforce the ties between schools and academic institutions in different areas of the south; and finally, facilitate the creation of multimedia content for teaching in francophone Africa. This plan is clearly based on the organization, production, and diffusion of knowledge and knowhow from higher education towards secondary education, through ICT in education.²⁶¹

- The French Cooperation supports the National University of Equatorial Guinea (UNGE) in their approaches by using ICT to develop centers for teaching and accessing

²⁵⁹ Hamet Aguemon and Yann Pambou, “Equatorial Guinea : Country Profile,” accessed July 13, 2012, http://fic.wharton.upenn.edu/fic/africa/Equatorial%20Guinea%20_2_.pdf, 3.

²⁶⁰ UNESCO, “Data Centre,” United Nations Educational, Scientific and Cultural organization, Institute for Statistics, accessed July 13, 2012, www.stats.uis.unesco.org.

²⁶¹ “Survey of ICT and Education in Africa,” Washington, DC: *infoDev* / World Bank, Volume 2: 53. Country Reports, accessed July 13, 2012, www.infodiv.org/en/Document.354.pdf.

digital teaching resources. The Malabo Center and the Bata Center, which opened in 2002 and 2005, respectively, run computer labs connected to high-speed Internet.²⁶²

- The RESAFAD-ICTE initiative, funded by the Cultural Cooperation and Action Service (SCAC), has been operating in Equatorial Guinea since July 2002. The initiative has created some multimedia centers that host several servers, training rooms equipped with workstations, and a room to produce educational resources. The center functions through a network, with branches located in the country linked with centers in other countries. Resafad-ICTE is reported to possess multimedia centers hosted by the National University of Equatorial Guinea.²⁶³

2. Social Status

Ranked 136 over 187 on the UNDP human-development index of 2011,²⁶⁴ Equatorial Guinea remains a country underdeveloped despite great oil resources. Since the discovery of oil and natural gas over a decade ago, Equatorial Guinea has become the richest country in sub-Saharan Africa (measured by GDP per capita). Despite this wealth, the majority remain extremely poor. With a population of just 633,000, oil and gas wealth has raised GDP per capita to over \$26,000, making Equatorial Guinea one of the world's high-income countries. Yet more than 60 percent of the population struggles to survive on less than U.S. \$1 per day. One measure of this extreme poverty is the high rate of child mortality, which increased between 1990 and 2006. The proportion of children dying before age five now is higher than some of the poorest countries in sub-Saharan Africa. The vast wealth of Equatorial Guinea appears not to have benefited its people.²⁶⁵

²⁶² Babacar Fall, "ICT in Education in Equatorial Guinea," *SURVEY OF ICT AND EDUCATION IN AFRICA: Equatorial Guinea Country Report*, June 2007, accessed July 13, 2012, <http://ddp-ext.worldbank.org/EdStats/GNQpro07.pdf>, 5.

²⁶³ Fall, "ICT in Education in Equatorial Guinea," 5.

²⁶⁴ "Regional and National Trends in the Human Development Index 1980-2011," *UNDP Report*, 2011, accessed July 12, 2012, <http://hdr.undp.org/en/data/trends/>.

²⁶⁵ "Equatorial Guinea: Facts Sheet N°9," *Center for Economic and Social Rights*, 2009, accessed July 13, 2012, <http://cesr.org/downloads/equatorial%20guinea%20WEB.pdf>, 4.

3. Access and Acceptance of Technology

Given the socioeconomic context and underdevelopment of the basic telecommunications networks, access to ICT is for now only possible in urban areas, where there are around 13,500 Internet subscribers, which represent about 2.1% of the population²⁶⁶ Cyber cafés remain the chief mode of access for the vast majority of Equatoguinean Internet users.

Currently, there are 23,260 Facebook users in Equatorial Guinea, which makes it number 181 over 213 in the ranking of all Facebook statistics by country. Facebook penetration in this country is 3.57% of the population, and 161.53% in relation to number of Internet users. The total number of FB users in GNQ is growing; it has increased by 5,080 in the last 6 months. This trend demonstrates a growing interest in social media by Internet users. The largest age group of social network users is currently 18–24 with total of 7,908 users, followed by the users aged 25–34.²⁶⁷ The Twitter database does not show any activity in Equatorial Guinea, although there are some Twitters accounts captioning topics on Equatorial Guinea, those accounts are usually operated by people outside the country, either for political activism or commercial purposes.²⁶⁸

Overall, it is hard to penetrate the society of Equatorial Guinea, which is locked by multiple factors like language (being from a Spanish culture, there is not too much material available online in English or French), the political climate, and protectionist behavior in a country is not favorable to foreign involvement of any nature. But from all reports, the country remains far behind its part of the subregion in term of ICT access and use by the general population.

²⁶⁶ According to UN DATA of 2009 the density of Internet user in GNQ is 2.1%. See “Country Profile: Equatorial Guinea,” *UNData*, accessed June 25, 2012, <http://data.un.org/CountryProfile.aspx?crName=Equatorial%20Guinea>.

²⁶⁷ “Equatorial Guinea Facebook Statistics,” *Social Bakers*, July 13, 2012, <http://www.socialbakers.com/facebook-statistics/equatorial-guinea>.

²⁶⁸ “Sanlitun Embassy area, Republic of Equatorial Guinea,” *WhoTalking.com*, March 2012, accessed July 13, 2012, <http://whotalking.com/flickr/Equatorial+Guinea>.

4. Information Technology Dependency

As confirm by the low level of activity in social media and lack of useful information on potential information systems operating in the country, IT use in Equatorial Guinea is still in its infancy. Although the state is engaged in infrastructural programs for interconnection to undersea fiber-optics cables, the level of corporate use of ICTs is very low. The use of applications depends entirely on the duties of the enterprise and is essentially concentrate on oil-production matters. Overall, there is no indication of dependency on technology at all in Equatorial Guinea.

E. CRIMINAL ACTIVITIES

Regarding the cybersecurity picture in Equatorial Guinea, nothing serious has come to attention from that domain. Despite of its involvement in regional collaboration, authorities in Equatorial Guinea still have to adopt and develop a legal framework of cyberspace. The types of cybercrime activities known in Equatorial Guinea, though rare, are essentially spam related.

The website ProjectHoneyPot.org, which conducts surveys of malicious activities online base on honey-pot servers has generate the results presented in Table 10. These results show the very low amount of malicious activities of coming from IP addresses within the Equatorial Guinea-allocated range of IP addresses.²⁶⁹ They essentially involve spammed IP addresses.

²⁶⁹ “Equatorial Guinea: Directory of Spam Server Ips,” *Honey Pot Project*, accessed July 13, 2012, http://www.projecthoneypot.org/list_of_ips.php?ctry=GQ&t=s.

Table 10. Honey Pot Results for Equatorial Guinea²⁷⁰

N°	Type of Attack	Period of activity of the 50 most recent IP	Total number of attempts registered
1	Harvester IP	July 2012	0
2	Spam Server IP	Feb 2008 – July 2012	1 407
3	Bad Web host IP	July 2012	0
4	Comment Spammer IP	May 2008 - July 2012	10
5	Dictionary Attacker IP	Jan 2008 - July 2012	1 758
6	Rule Breaker IP	July 2012	0
7	Search Engine IP	July 2012	0

F. CONCLUSION

Oil has brought great wealth and growth to the Equatoguinean economy, but challenges remain. Real GDP has increased forty-fold since 1995, and large oil revenues have allowed the government to embark on an ambitious infrastructure-investment program while amassing foreign savings. Basic infrastructure is being developed as well as the telecommunications sector.²⁷¹ One can only expect that all aspects of ICT will be addressed in the upcoming years.

²⁷⁰ “Equatorial Guinea: Directory of Spam Server Ips,” *Honey Pot Project*.

²⁷¹ “Equatorial Guinea: Recent Developments & Prospects,” *African Economic Outlook*, June 22, 2012, accessed July 13, 2012, <http://www.africaneconomicoutlook.org/en/countries/central-africa/equatorial-guinea/>.

APPENDIX F. THE REPUBLIC OF THE CONGO

Located in Central Africa, the Republic of the Congo is endowed with immense natural resources: oil reserves, rich forest, mineral resources, fauna, and hydrographic network. Since its independence in the sixties, the Republic of Congo has been plagued by multiple civil war and political instability. In the early 2000, the country regained a relative stability and a new constitution was ratified in 2002 opening the path to democratization.

The Congolese economy has grown significantly since 2008. Real GDP is estimated to have expanded by 8.8 percent in 2010, compared to 7.5 percent in 2009, based on continued high growth in the oil-sector as well as accelerated growth in the non-oil sector. Economic growth was projected to 5.0 percent in 2011. In this context of general growth, Information Technologies did also follow the movement, leading the Congolese telecommunications systems to one of the most dynamic of the subregion. Though ICT has not yet penetrated every facet of life in Congo, the government clearly shows that it is a focus and is committed to do so.

In 2006, The Korea Agency for Digital Opportunity and Promotion (KADO) and the International Telecommunication Union (ITU) evaluate the country Digital Opportunity Index (DOI) to 0.17 in a scale of 0 to 1 for a rank of 152/181.²⁷² Nevertheless, along with other effort of nation building, the sector of Information

²⁷² "The Digital Opportunity Index (DOI)," *World Information Society Report 2007*, Chapter Three, ITU-UNCTAD (2007), <http://www.itu.int/ITU-D/ict/doi/material/WISR07-chapter3.pdf>, 38.

Technology has seen some improvement this last decade. Good progress has been made in developing mobile telephony market in recent years, with high levels of signal coverage. The cost of international connectivity which was initially high is expected to significantly drop with the country connection to the international submarine cable and the complete interconnection by a domestic fiber optic network. Conversely, the physically dilapidated and financially depleted condition of the fixed-line telephone operator is becoming a constraint to raising Internet penetration.

Table 11. Socioeconomic Indicators: Republic of Congo²⁷³

N°	Indicator	Value
1.	Area	342,000 square km
2.	GDP	\$18.48 billion (2011 est.)
3.	Official language	French
4.	Total population	4,366,266 (July 2012 est.)
5.	Population rate between 0-14 years	45.6% (male 973,332/female 960,100)
6.	Population 15-64 years	51.7% (male 1,091,531/female 1,101,057)
7.	Life expectancy	55.27 years
8.	Urbanised population	62% of total population (2010)
9.	Average annual growth rate of urban population	3% (2011 est.)
10.	Per capita gross national income (US dollars) GNI	1 379
11.	Population below \$1 a day	54.1% (2005)

A. INFRASTRUCTURES

Most of the telecommunications network, including the national microwave transmission backbone, was destroyed during the multiple civil wars, leaving only one telephone exchange at Pointe-Noire in an acceptable operational shape. Since then, Congo Telecommunications has undertaken a limited infrastructure rehabilitation program. The core of the network is essentially using wireless connections based on HF and VHF links.

²⁷³ "Africa: Republic of Congo," *The CIA World FactBook*, June 25, 2012, accessed July 25, 2012, <https://www.cia.gov/library/publications/the-world-factbook/geos/cf.html>.

The fixed line density in the Republic of Congo is low and declining. Coverage was 0.41 subscribers per 100 people in 2005. That figure dropped to 0.35 subscribers per 100 people in 2007 from 0.24 in 2008. Moreover, the quality of the fixed line network is rapidly deteriorating, and it is becoming a constraint to expanding and improving ICT services. To overcome this deteriorating trend of landlines communication, mobile services have exploded. Due to a liberalization policy of the sector by the government, competition has increased in the Republic of Congo's mobile market in recent years. As a result, about 70% of the country's population is covered by a GSM signal.²⁷⁴ Mobile telephony penetration is relatively high (90%) compare to the neighboring countries and reaches 35 percent. In 2003 there were 330,000 subscribers, and by the end of 2007, this had risen to an estimated 760,000 served by three key mobile operators: Zain Bharti Airtel, MTN Congo, and Warid Telecom. A fourth operator entered the market in 2010.

Despite the competition observe in the mobile sector, fixed telephony remains in the hands of the public monopoly, Congo Telecom, the former "Société des Télécommunications du Congo, or SOTELCO." Despite a desire to privatize this company, the financial instability of the company did not aloud that process to go through. Additionally, poor availability, high costs and slow speeds for installation of fixed line services have obstructed the market for Internet access in the Republic of Congo. At the end of 2009, there were only 15,000 Internet subscribers in the country, the bulk of which connected via GPRS (General Packet Radio Service) networks. ADSL (Asymmetric Digital Subscriber Line) connections in May 2010 totaled just 121, of which only eleven had access to downlink speeds of 512kbps, the highest rate recorded at the time. The number of broadband subscribers was estimated to reach 124 in September 2010.²⁷⁵

²⁷⁴ "Becoming an ICT hub for Central Africa," *China Daily*, June 29, 2012, accessed July 26, 2012, http://www.chinadaily.com.cn/cndy/2012-06/29/content_15533978.htm.

²⁷⁵ "Fixed broadband Internet subscribers in Republic of the Congo," *Trading Economics*, accessed July 25, 2012, <http://www.tradingeconomics.com/republic-of-the-congo/fixed-broadband-internet-subscribers-wb-data.html>.

Internet Services are provided to the population by a total of ninety two²⁷⁶ operators using principally *dial-up* and *wireless local loops* technologies for distribution, essentially WiMAX technology, but prices are still high and the Internet access very slow, due to the fact that Congo still rely on costly satellite connectivity for international Internet access. Although there is internal mobile competition, the cost of international connectivity is high in the Republic of Congo and is considered to be more expensive than in most of Africa.

The Republic of Congo has committed to undertake several transformational ICT projects. First, the *projet couverture nationale* is intended to extend broadband access to remote areas and get closer to broadband universal access. Second, the country is on his way to connect to the West Africa fiber optic cable system through the Project West Africa System Cable (WACS). Indeed, the Republic of the Congo recently signed an agreement to connect to the submarine cable through the WACS Project, which is a planned submarine communications cable linking South Africa with the United Kingdom along the west coast of Africa.²⁷⁷ And finally, it is engage in a process of implementing an effective connectivity strategy, and a use of the connectivity to increase government efficiency as part of the World Bank financed Project CAB CITCG.²⁷⁸ Continuing in the same perspective of diversification of its broadband access means, Congo is member of the African satellite project RASCOM.²⁷⁹ The Republic of the Congo does not yet possess an Internet Exchange Point (IXP), but since May 2011 the country has made clear it intension to have one.

The Republic of the Congo's power sector is underdeveloped in terms of generation capacity, power consumption, access, and reliability. Though the country no

²⁷⁶ "Broadband Internet Service Providers (ISP) in Congo," *Who Is This IP*, accessed July 25, 2012, <http://www.whoisthisip.com/isp-ip-usage-country-Congo.php>.

²⁷⁷ "WACS on, hats off to African submarine bandwidth," *Telegeography*, May 2012, accessed July 25, 2012, <http://www.telegeography.com/products/commsupdate/articles/2012/05/01/wacs-on-hats-off-to-african-submarine-bandwidth/>.

²⁷⁸ République du Congo (CG), "Stratégie Nationale pour le Développement des Technologies de l'information et de la Communication (TIC) en République du Congo," *Ministère des Postes et Télécommunications*, December 2004, accessed July 25, 2012, www.observatoireitc.org/documents/download/46.

²⁷⁹ "Members of the RASCOM Project," *RASCOM*, March 2005, accessed June 28, 2012, http://www.rascom.org/info_detail.php?langue_id=1&id_r=7&id_sr=0&id_gr=2

longer depends on imports from the Democratic Republic of the Congo, the power supply is unreliable. Frequent outages have forced firms and households to accumulate a stock of self-generation capacity of 207 MW. The stock of self-generation capacity represents nearly 60% of the capacity of the national system. Access to electricity is very low in both urban and rural areas, but the situation is particularly dire in rural areas—rural access to electricity is only 16.74 percent. Despite the low quality of service, power tariffs remains very high although the country's energy system is predominantly hydroelectric. The national power utility, Société Nationale d'Electricité (SNE), is the main source of inefficiencies in the sector. Transmission and distribution losses are 47 percent of power generated. The associated financial losses are equivalent to 37 percent of SNE's revenue. This is likely due to lack of maintenance and rehabilitation of the existing distribution network and a permissive policy regarding illegal connections. The high rate of overstaffing also contributes to the low performance of the company. Finally, the utility only collects 88 percent of billings. These significant difficulties hamper SNE's ability to recover costs and therefore limit investment in rehabilitation and system expansion.

Only the south of the country has access to grid electricity from SNE, while the north has to rely on costly off-grid generation. As a result, the effective price of power is three times higher in the North. For example, all forest concessionaires in the north (and some in the south) are too remote to benefit from grid electricity and must rely on diesel powered own generation facilities for onsite timber processing.

The government had ambitious plans to double access to electricity by 2011. Efforts are underway to upgrade generation and transmission capacity to reach this goal. The country currently has a generation capacity of around 361 MW: the hydroelectric plants in Moukoulou and Djoué provide 74 MW and 15 MW, respectively, the gas powered thermal plant in Brazzaville provides 32 MW, the newly commissioned gas fired plant at Pointe Noire with a capacity of 150 MW and the Imboulou hydroelectric power station currently produces 90 MW. The capacity of Imboulou hydroelectric dam located 215 km north of Brazzaville, being built by a Chinese company will be increased to 120 MW through the commissioning of the fourth unit later this year. The capacity of

the gas fired power plant in Pointe-Noire will be doubled to 300 MW in 2011. Transmission improvements are also planned. In particular, the transmission line from Pointe-Noire to Brazzaville will be rehabilitated and extended northward in the direction of Ouando (550 km from the capital).²⁸⁰

The Republic of the Congo has no ICT industrial facilities; all ICT equipment is imported, including access equipment (radio and television sets, computers, telephones) as well as routine-maintenance equipment. The country is totally dependent on imports as far as the acquisition of equipment and software for ICT development are concerned.

B. INFORMATION SYSTEMS, BUSINESS, AND INDUSTRIES

As for most of the countries in the Africa, apart from proprietary systems used for telecommunication infrastructures, the vast majority of OSs in use in the Congo (Brazzaville) are Windows based, generally the initial system delivered with personal computers. Services offered in Congo cyberspace are essentially web hosting, communications (VOIP, SMS, e-mail), and web navigation.²⁸¹

Access to ICTs has significantly changed Congolese society. Companies that use ICTs are improving their performances. As a result of ICTs, many projects are being implemented. The banking sector has experienced a significant change from the use of ICTs. Customer transactions are no longer performed manually. This has not only reduced the waiting time for customers, but also improved working and living conditions for bank agents. Today, cards for automated teller machines (ATMs) allow users to carry out banking operations at any time. Several innovative services and jobs are also created through ICTs. These include the development of agencies for fund transfers through major localities of the country and express parcel-delivery services. It has made it easy

²⁸⁰ Nataliya Pushak and Cecilia M. Briceño-Garmendia “The Republic of Congo’s Infrastructure: A Continental Perspective,” *AICD Country Report*, October 2011, accessed July 25, 2012, http://www-wds.worldbank.org/servlet/WDSCContentServer/WDSP/IB/2011/10/06/000158349_20111006112218/Rend ered/PDF/WPS5838.pdf, 11.

²⁸¹ René Samba and Jean J. K. Biampikou, “Capital Humain, TIC et Entrepreneuriat en République du Congo: Cas des PME dans les Villes de Brazzaville et de Pointe-Noire,” *Fonds de Recherche sur le Climat d’Investissement et l’Environnement des Affaires*, April 2012, accessed July 26, 2012, http://www.trustafrica.org/documents/research_findings/Samba-edited.pdf, 15.

and fast to transfer funds to a family member or business partner located in centers around the country. The transfer is automatic, using a phone and a computer. As in the neighboring DRC, mobile banking is taking off consistently in the Republic of the Congo.²⁸² ICT-related companies, mainly GSM mobile companies, are now amongst the biggest employers in the Republic of the Congo. Formal and informal enterprises, including travel agencies, have sprung up as a direct and indirect result of mobile operators.²⁸³

IT engineering providers (software engineering, networks and applications) are well spread across the majors cities of the countries and are organized as small and medium enterprises (SME). In the rural areas, these SMEs work with NGOs to offer IT services that fit some of the needs of the population for their daily tasks.

In the public sector, the Republic of the Congo is ranked 157/190 on the 2012 index of electronic government by the United Nations, dropping nearly 20 steps since 2010.²⁸⁴ Currently, several projects of implementation of networks and computerization are introduced by diverse government administrations and are producing interesting results in terms of easiness of public services. The Congolese administration, including security services, has brought out computerized identity cards and biometric passports. The time for obtaining these identity cards has been significantly reduced from several months to a few weeks, or even days.²⁸⁵

C. LAWS, REGULATIONS, AND ORGANIZATION

1. Strategies and Policies

In the Republic of the Congo, the national ICT policy was formulated in 2004 and was aimed to reduce poverty and introduce the Congolese population to the information

²⁸² Sam Moss, "FirstRand Expands Further In Africa," *First Rand*, March 30, 2005, June 29, 2012, <http://www.firstrand.co.za/content/291/firstrand-expands-further-in-africa/>

²⁸³ "République du Congo : Country Report," *AZUR Développement*, 2008, accessed July 26, 2012, <http://www.giswatch.org/node/346>.

²⁸⁴ "E-Government Survey 2012," *United Nation*, New York (2012), accessed June 29, <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan048065.pdf>

²⁸⁵ "République du Congo : Country Report," *AZUR Développement*, 2008, accessed July 26, 2012, <http://www.giswatch.org/node/46>.

era.²⁸⁶ To do this, several objectives were established: accelerate the development of a viable and sustainable economic network that will contribute to job creation; support ICT access for populations living in cities and rural and disadvantaged areas; secure ICT infrastructure; define a legal and regulatory framework adapted to ICTs; develop ICT capacities and transform the educational system by means of ICTs; and finally, promote good governance by utilizing ICTs. The implementation of the policy has not been easy. Over the last decade, there have been many changes of ministers of postal services and telecommunications, who are in charge of new technologies. At the same time, few institutions and NGOs in the Republic of the Congo were involved in ICT policy and the ICT sector.²⁸⁷

To maintain its effort in promoting the development of ICT in the Congo, in April 2012 the government signed a contract with a French company, *NexrtiraOne*, for the definition of a national grand strategy for information technology.²⁸⁸

2. Laws, Regulations, and Organization

In 2009, the Congo designed and adopted a new policy and strategic vision for the ICT sector, a roadmap intended to bring the country to the next stage of ICT connectivity, with the goal of becoming a regional ICT hub. Using the “heavily indebted poor countries” process in which the Republic of the Congo was engaged from 2006 to January 2010, the country wisely established a new regulatory framework for the telecommunications sector that opens the way to competition in international gateways and services, and local wireless distribution. Along with the liberalization process, the new legislation creates an independent telecommunications regulatory authority (ARPCE) to ensure clear and transparent regulatory regimes.

²⁸⁶ République du Congo (CG), “Stratégie Nationale pour le Développement des Technologies de l’information et de la Communication (TIC) en République du Congo,” *Ministère des Postes et Télécommunications*, December 2004, accessed July 25, 2012, www.observatoireitc.org/documents/download.

²⁸⁷ “République du Congo : Country Report,” *AZUR Développement*, 2008, accessed July 26, 2012, <http://www.giswatch.org/node/46>.

²⁸⁸ “NTIC : Un schéma directeur pour conduire la politique nationale,” *Les Dépêches de Brazzaville*, April 9, 2012, accessed July 26, 2012, http://www.brazzaville-adiac.com/index.php?action=depeche&dep_id=58594&oldaction=liste®pay_id=0&them_id=0&cat_id=5&ss_cat_id=42&LISTE_FROM=0&select_month=04&select_year=2012, 1.

The legal and regulatory framework for the telecommunications sector is quite complete and addresses most of the aspects of legal issues. But there are still questions about cybersecurity, cyber liberties, and electronic commerce to be resolved. The authorities of the Republic of the Congo are involved in a subregional consultation for a common legal platform for cybersecurity.

D. INFORMATION TECHNOLOGY IN THE SOCIETY AND CULTURE

1. Education

Education and training facilities are mostly concentrated in the large cities of Brazzaville and Pointe-Noire, and most of the country does not have sufficient educational institutions. Although the educational sector was significantly damaged during the civil war, the government has worked hard to rehabilitate it with international assistance.²⁸⁹

According to the World Bank ICT report on education in 2007, ICTs are not yet part of the national curriculum. In some schools, there are no computers for learners. Only the national university, Marien Ngouabi University in Brazzaville, has faculties or departments that have integrated computer-training modules into their coursework. The digital campus at the university, Agence Universitaire de la Francophonie (AUF), offers distance learning and provides both students and teachers with easy access to the Internet. There is also a distance-learning program affiliated with Cisco in the faculty of sciences.²⁹⁰

For a long time, students from the Republic of the Congo have travelled abroad to study computer science at the postgraduate level. Most of them enroll in universities and colleges in the Democratic Republic of the Congo, France, and other African countries. Several NGOs, such as AZUR Development, the IT Professionals Association (AIP), the Committee for the Promotion of Information Technologies in Congo (COPTIC), and the

²⁸⁹ “BTI 2012 Congo, Rep. Country Report,” *Bertelsmann Stiftung*, Accessed August 03, 2012, <http://www.bti-project.org/fileadmin/Inhalte/reports/2012/pdf/BTI%202012%20Congo%20Rep..pdf>, 21.

²⁹⁰ Babacar Fall, “ICT in Education in the Republic of Congo (Congo-Brazzaville),” *World Bank – InfoDev*, June 2007, accessed August 03, 2012, <http://ddp-ext.worldbank.org/EdStats/COGpro07.pdf>.

Congo Community Telecenters Network, provide access to computer equipment and training in basic computer skills. There are also several schools and private centers across the country training senior technicians in the field of IT, including the maintenance of networks and computer systems. State-owned enterprises such as the Congolese Informatics Office provide training and offer ICT-related services.²⁹¹

2. Social Status

Congo-Brazzaville continues to face enormous economic and social challenges left over from years of civil war and political turbulence. Ranked 137 over 187 on the UNDP human-development index of 2011,²⁹² the Republic of the Congo remains a country underdeveloped despite its oil resources. More than 50% of the population is living in a situation assessed as extreme poverty by international standards. A very tiny class of people in the state elite, military, and business circles can be perceived as rich, while the middle class is small. Poverty, along with a low standard of economic and social development in the non-oil sectors of the country, has impaired the ability of individuals and society to organize. Although oil is the backbone of economic development and the elites, the majority of the population is forced to rely on the informal sector and subsistence agriculture to survive. Extended families, village communities, and women's groups are major frameworks of solidarity and self-organization. Within these forms of self-organization, interpersonal trust appears to be high.

On a more national scale, however, matters are very different. Due to the increasing dominance of Cuvette regionals in high-level political positions and economic affairs, southerners and northerners are extremely distrustful of each other, more

²⁹¹ "République du Congo : Country Report," *AZUR Développement*, 2008, accessed July 26, 2012, <http://www.giswatch.org/node/346>.

²⁹² "Regional and National Trends in the Human Development Index 1980-2011," *UNDP Report*, 2011, accessed July 12, 2012, <http://hdr.undp.org/en/data/trends/>.

commonly viewing each other as adversaries to be defeated than compatriots. The civil wars between 1993 and, to some extent, the present are both evidence and aggravator of this.²⁹³

3. Access and Acceptance of Technology

Penetration of ICT is small. The proportion of households with a computer was, in 2007, 0.3% (against 10.1 in Cameroon, 5.0 in Congo Brazzaville, and 4.3 in the Gabon) and households having access to the Internet was 0.2 % (against, respectively, 5.2, 1.4, and 3.6 in countries above).

For now, wireless technology seems to provide the best hope to bridge the digital divide. This has been demonstrated by the imaginative use of GSM phones. The development of services such as mobile broadband and WiMAX that offer scalable solutions provides for access to low-income communities as well as developed communities in sparsely settled areas.

Multimedia and digital technology has revolutionized the habits of the Congolese population. Mobile phones and digital cameras now film the events of society. Digital photos are developed quickly. Before, the process was quite long and involved expensive equipment and training. ICTs have also made a considerable contribution to state administration and the revision of the electoral register.

In education, ICTs have proven themselves with the introduction of bar codes for examinations. Results for secondary schools and higher institutions are now published on the Internet. In the past, it could take several weeks, or even months, for students to access their results, especially for students living in rural areas. Several other projects using ICTs are being implemented or planned. These include the incorporation of ICTs in immigration control and the computerization of the port authority.

Thanks to the economies of scale generated by the vast global market, the cost of buying and using a mobile phone is falling steadily and mobile penetration is rising

²⁹³ “BTI 2012 Congo, Rep. Country Report,” *Bertelsmann Stiftung*, Accessed August 03, 2012, <http://www.bti-project.org/fileadmin/Inhalte/reports/2012/pdf/BTI%202012%20Congo%20Rep..pdf>, 18.

rapidly in the country. There is, nevertheless, still much to do to improve the affordability of telecommunications. Some of the Congolese regard mobile phones and broadband Internet as luxuries rather than essential communications tools. In large cities, the Congolese have access to the Internet in cybercafés, mainly to read and send e-mails. More and more young people go to cafes to use social networks, but the very slow connection speed generally prevents video playback.

Currently, there are 89,680 Facebook users in the Republic of the Congo, which makes it number 150 over 213 in the ranking of all Facebook statistics by country. Facebook penetration in the Congo is 2.17% of the country's population and 36.57% in relation to the number of Internet users. This number has been steadily increasing over the past six months, showing a serious interest in social media by the population. The largest age group of social network user is currently 18–24, with 33,182 users, followed by those aged 25–34.²⁹⁴ The Twitter database on the Social Bakers website does not show any activity from Congo, but there are some Twitter accounts captioning topics on the Congo that can be found when browsing online, those account are usually operated by people outside of the country, either for online activism of all sorts or commercial purposes.²⁹⁵

4. Information Technology Dependency

Although the level of utilization of the Internet and ICT is relatively interesting for the subregion, multiple limitations from infrastructure, energy, bandwidth, and others hinder the wide spreading of ICT. Thus, for now, the country is not dependent on technology for its daily survival.

²⁹⁴ “Republic of Congo Facebook Statistics,” *Social Bakers*, August 3, 2012, <http://www.socialbakers.com/facebook-statistics/republic-of-the-congo>.

²⁹⁵ “Get instant updates on #Brazzaville,” *Twitter*, accessed August 3, 2012, <http://twitter.com/#!/search/%23Brazzaville>.

E. CRIMINAL ACTIVITIES

The growing use of ICTs in the Congo has been followed by some collateral misbehavior, which include fraud practices at all levels, access to pornography on television and the Internet, and cyber scams.

A survey conducted by the website ProjectHoneyPot.org, which track malicious activities online base on honey-pot servers generated the results presented in Table 12. These results show a relatively low amount of malicious activity coming from IP addresses within the Republic of the Congo's allocated range of IP addresses.²⁹⁶ These malicious activities essentially concerned spamming and dictionary attackers.

Table 12. Honey Pot Results for the Republic of the Congo²⁹⁷

N°	Type of Attack	Period of activity of the 50 most recent IP	Total number of attempts registered
1	Harvester IP	July 2012	0
2	Spam Server IP	Feb 2008 – July 2012	15 720
3	Bad Web host IP	July 2012	0
4	Comment Spammer IP	May 2008 - July 2012	2 273
5	Dictionary Attacker IP	Jan 2008 - July 2012	17 339
6	Rule Breaker IP	July 2012	0
7	Search Engine IP	July 2012	0

²⁹⁶ "Republic of Congo: Directory of Spam Server Ips," *Honey Pot Project*, accessed July 13, 2012, http://www.projecthoneypot.org/list_of_ips.php?ctry=CG&t=s.

²⁹⁷ "Republic of Congo: Directory of Spam Server Ips," *Honey Pot Project*.

F. CONCLUSION

Despite being among the last countries to acquire ICTs, due to political instability, the Republic of the Congo is now on the road of development, making some huge strides in the ICT sector. Although there have been some significant political and strategic moves to improve the ICT sector, much remains to be done to fully grasp the potential available through ICT. Particularly in the domain of cybersecurity and regulation of cyber transactions, the country still needs a suitable legal framework along with the infrastructure and qualified personnel to enforce them.

APPENDIX G. THE REPUBLIC OF SÃO TOMÉ AND PRÍNCIPE

Sao Tomé and Príncipe (STP) is a small island nation on the equator off the central west coast of Africa. It comprises two principal islands: Sao Tome, and Principe, with a total area of 964 km² of land. A Portuguese colony until 1975, the island is essentially an agricultural and fishery-based economy. Cocoa is the primary export crop, grown on what were once large Portuguese estates. Starting with little, the country has slowly evolved from a single-party socialist state into a vibrant multi-party democracy. STP is admired for its free press, the absence of serious human-rights abuses, and for one of the highest literacy rates in Africa. Unlike many African countries, it is free of ethnic tensions and violent crime.

STP is also a poor country, with a GDP per capita of around USD 1,222 in 2011. With a population of nearly 183,176 inhabitants in the 2011 estimation, it constitutes a small domestic market that lacks attractiveness for international investors. However, STP, which lies in the Gulf of Guinea (a well-known oil zone), is endowed with oil resources yet to be fully exploited. On the UNDP human-development index of 2011, the country is ranked 144 over 187.²⁹⁸

Telecommunications is one of the bright spots of STP's infrastructure, with indicators significantly better than those of most African countries. Indeed, the country was ranked 159/182 on the ITU digital-opportunity index (DOI) (0.15 in a scale of 0 to 1) in 2007.²⁹⁹ The long-standing monopoly of the Companhia Sãotomense de Telecomunicações (CST), which was 51% owned by a Portuguese company, with the remainder held by the São Tomean government, ended in 2007, and the market was opened to competition. The mobile cellular network is also growing rapidly. Internet use is still low because of the high costs involved. But Internet cafés are popular with young

²⁹⁸ "Regional and National Trends in the Human Development Index 1980-2011," *UNDP Report*, 2011, accessed July 12, 2012, <http://hdr.undp.org/en/data/trends/>.

²⁹⁹ "The Digital Opportunity Index (DOI)," *World Information Society Report 2007*, Chapter Three, ITU-UNCTAD (2007), <http://www.itu.int/ITU-D/ict/doi/material/WISR07-chapter3.pdf>, 38.

people. While it is possible to call anywhere in the world, with very good lines from São Tomé and Príncipe, calling into the country is often difficult from the United States and Europe. Internet dial-up service and high-speed broadband remain excessively high.

The following indicators show the status of efforts in the telecommunications sector: the penetration rate of telephony services is estimated at 60.83% of the population, with a landline teledensity of 4.82% and mobile teledensity of 54.81% in 2011. Internet penetration rate is estimated to reach around 19.217% of the population.³⁰⁰

Table 13. Socioeconomic Indicators: Sao Tome and Principe³⁰¹

Nº	Indicator	Value
1-	Area	964 sq km
2-	GDP	\$306 million (2011 est.)
3-	Official languages	Portuguese (official)
4-	Total population	183,176 (July 2011 est.)
5-	Population rate between 0-14 years	44.7% (male 40,777/female 39,386)
6-	Population rate between 15-64 years	52.2% (male 46,114/female 47,509)
7-	Life expectancy	63.49 years
8-	Urbanized population	62% of total population (2010)
9-	Average annual growth rate of urban population	2.8% annual rate of change (2010-15 est.)
10-	Per capita gross national income (US dollars) GNI	\$ 1,130 ³⁰²
11-	Population below \$1 a day	28,6% ³⁰³

³⁰⁰ “Country Profile: Sao Tome & Principe,” *WorldBank Data*, July 2012, accessed July 16, 2012, <http://data.worldbank.org/country/sao-tome-and-principe>.

³⁰¹ “Country Profile: Sao Tome & Principe,” *The CIA World FactBook*, June 20, 2012, accessed July 2012, <https://www.cia.gov/library/publications/the-world-factbook/geos/tp.html>.

³⁰² “Country Profile: Sao Tome & Principe,” *WorldBank Data*, July 2012, accessed July 16, 2012, <http://data.worldbank.org/country/sao-tome-and-principe>.

³⁰³ “Population below \$1 (PPP) per day, percentage,” *UNData*, accessed July 15, 2012, http://data.un.org/Data.aspx?d=MDG&f=seriesRowID%3A580#f_1.

A. INFRASTRUCTURES

Made of a digital-switch network, the telecommunications infrastructure in STP is quite modest and is considered adequate to provide ICT services to its tiny population. Until last year, the Companhia Santomense de Telecomunicações (CST), a state telecommunications joint-venture company, was the sole provider of ICT services in the country, of which 51 percent is owned by Portugal Telecommunications International (PTI). Mobile service, which was launched six years ago, rapidly became CST's main business area, accounting for over 60 percent of revenues. According to a recent declaration, CST plans to launch third-generation services in 2012, when the country will achieved its connection to the intercontinental undersea cable. Early in 2012, the government announced the grant of a second telecommunications license to another operator.³⁰⁴

Internet services are provided exclusively by Tecnologia de Sistemas Informático, the main enterprise of the local computer community, which is jointly administered by the government and Bahnhof Internet AB of Sweden.³⁰⁵ While waiting for optical fiber connection, satellite solutions remain the principal means of connection with the world, as well as for ICT access in remote areas. Meanwhile, urban communications are dominated by technologies like ADSL, GSM, and WIFI. Internet access remains limited, although Internet cafés have spread to all major urban centers (islands).

In 2011, the World Bank's board of directors approved the finance of a major telecommunication project for STP. The project aimed at boosting information technology infrastructure and access to services in the Republic of São Tomé and Príncipe. Specifically, the country received a grant of US\$ 14.9 million from the bank for its component in the CAB program. With this support, STP is expected to connect to

³⁰⁴ "São Tomé and Príncipe: Une licence octroyée à un deuxième opérateur des télécommunications," *Balancing Act*, November 2011, accessed July 16, 2012, <http://www.balancingact-africa.com/news/fr/edition-fran-aise-25/171/actualit-s-t-l-com/s-o-tom-and-pr-ncipe/fr>.

³⁰⁵ Ewan Sutherland, "Telecommunications in Africa: Small Island Developing States" *ITU Telecom Africa* Cairo, 12 to 15 May 2008, accessed July 16, 2012, <http://works.bepress.com/ewan/15>.

undersea cable by the end 2012.³⁰⁶ STP does not possess or plan to possess an Internet Exchange Point (IXP), but as a member of the CAB project, will certainly benefit from the infrastructure empowered in the project.

Electrical production, estimated to be of 15 million kilowatt hours (kWh), comes from two main sources: imported fossil fuel (which generates up to 47 percent of total power) and hydroelectric power (up to 53 percent), generated from the nation's abundant water supply. However, only 53 percent of households have electricity and there are regular power cuts. A number of important measures have been taken to address these constraints. The electricity agency is planning to increase its capacity (through mini hydropower plants among other things).

B. INFORMATION SYSTEMS, BUSINESS, AND INDUSTRIES

Not much information is available on various information systems used in STP. But all the indications suggest an incipient phase in the development of information systems. The operating systems at the level of the end-user are Windows based; computers essentially are used for office support tasks. As usual, industrial infrastructures use proprietary OSs and their types are likely tied to the companies' internal policies. Services offered by telecommunication companies are fully digitalized and reasonably efficient from a technical point of view, though there is a serious shortage of Internet capacity.

The services offered in cyberspace revolve around web hosting, communications (VOIP, SMS, e-mail), and web navigation. Electronic commerce has yet to be introduced. Some few small and medium enterprises (SME) marketing ICT products and services exist and are based mainly in the capitals cities, Sao Tomé and Príncipe. Most of them are local branches of foreign firms, or have concluded local representation agreements with such firms (software solutions, networking solutions, IT security). The country is totally dependent on imports as far as the acquisition of equipment and software for ICT

³⁰⁶ "World Bank grants over US\$70 million for infrastructure development in Liberia, Sierra Leone and Sao Tome and Principe," *Balancing Act*, January 28, 2011, accessed July 16, 2012, <http://www.balancingact-africa.com/news/en/issue-no-539/money/world-bank-grants-ov/en>.

development are concerned. However, there are some companies that provide industrial services such as the assembling and distribution of personal computers.

In the public sector, Sao Tomé and Príncipe is ranked 138/190 (thus regressing 10 steps since 2010) on the index of electronic governments by the United Nation in its 2012 survey,³⁰⁷ showing a slowdown in the effort to use information technology in government. However, at the regional level, the country scores second in the e-government readiness process. This good position in the regional ladder is certainly due to the small size of the country and the administrative apparatus that goes with it. The national website of Sao Tome and Principe, though providing mostly static information, has archived data including sectoral information on health, education, and the economy.

There is no evidence of interconnection projects between different entities of the government or the development of information systems in order to increase the quality of services in the public administration.

C. LAWS, REGULATIONS, AND ORGANIZATION

1. Strategies and Policies

The country is not officially known to possess a NICI plan, and there is no information about the preparation of such a plan. Although a strategic plan for ICT does not exist, the government of Sao Tomé and Principe have ICT included in its millennium goals of development.³⁰⁸ Additionally, there have been significant moves made by the government to enhance telecommunications in the country, like the ending of the monopoly of the incumbent operator and the ongoing connection of the country to the undersea optical fiber. Accountable for this endeavor is the 2006 creation of a regulatory authority of the telecommunications sector, the Autoridade Geral de Regulação (AGER), responsible for electricity, posts, telecommunications, and water.³⁰⁹

³⁰⁷ “E-Government Survey 2012,” *United Nation*, New York (2012), accessed June 29, <http://unpan1.un.org/intradoc/groups/public/documents/un/unpan048065.pdf>, 17.

³⁰⁸ “Sao Tomé and Principe: Interim Country Strategy Paper 2010-2011,” *Africa Development Bank*, July, 2010, accessed July 17, 2012, <http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/Sao%20Tome%20and%20Principe%20-%20CSP%202010-2011%20doc.pdf>, 13.

³⁰⁹ “Telecomunicações,” accessed July 17, 2012, <http://www.ager-stp.org/>.

2. Laws, Regulations, and Organization

The legal and regulatory framework for the telecommunications sector in Sao Tome and Principe is still rudimentary. Two entities are in charge of the telecommunications sector: the regulatory authority AGER, which is an independent body, and the CST, a public-private joint venture in charge of exploitation of telecommunications.

The telecommunications sector is ruled by a law enacted in 2004 that defined the conditions for the establishment, management, and operation of telecommunications networks and services.³¹⁰ Since then, other amendments and laws have completed the legal framework.

Sao Tome and Principe is a member of several international organizations, one of which is the ITU. At the regional level, it is active in the work of ECCAS in the area of telecommunications and has participated in the region's efforts to harmonize the legal framework for telecommunications.

D. INFORMATION TECHNOLOGY IN THE SOCIETY AND CULTURE

1. Education

Education in STP is universal, compulsory through sixth grade, and tuition-free to the age of 15. Families have to buy books and school uniforms, though they are provided free to children from poor families. Primary school begins at seven and continues for six years. The pupil/teacher ratio in primary school is 32:1. Secondary education starts at age 13 and is finished in five years. The literacy rate is 87.9% for those 15 years and older.

Although the literacy rate is high in STP, like most least-developed countries, STP faces serious shortages of skills in the public sector and government. Skilled workers can earn three times as much as unskilled. Recent years have seen the growth of new technical schools and postsecondary training centers, as well as two new universities that should soon produce well-trained graduates.

³¹⁰ “Decreto-Lei nº Lei nº 3/2004,” July 2, 2004, July 17, 2012, <http://www.ager-stp.org/>

In the absence of a national strategy for ICT development, the educational policy towards new technologies in STP remains vague. Few clues have been found to show a serious emphasis on ICT training in general.

2. Social Status

Sao Tome and Principe is ranked 144 over 187 on the UNDP human-development index of 2011.³¹¹ Although some positive steps have been made, approximately 54% of its population of 166,000 remains in poverty and 15% live in extreme poverty. The poverty remains widespread in rural and peri-urban areas. Urban migration is on the rise, due to the lack of employment opportunities in rural areas.³¹²

3. Access and Acceptance of Technology

Access to ICT is for now only possible in urban areas, where there are around 31,012 Internet users as of December 31, 2011, which represent about 17.3% of the population. Cyber cafés remain the chief mode of access for the vast majority of Saotomean Internet users.

Currently, there are 5,420 Facebook users in Sao Tome and Principe, which makes it number 206 over 213 in the ranking of Facebook statistics by country. Facebook penetration represents 3.08% of the population, and 20.30% in relation to the number of Internet users. The total number of FB users in STP is growing; it has increased by 2,100 in the last six months. This trend demonstrates a growing interest in social media by Internet users. The largest age group of social network user is currently 25–34, with a total of 1,789 users, followed by users aged 18–24.³¹³ The Twitter database does not

³¹¹ “Regional and National Trends in the Human Development Index 1980-2011,” *UNDP Report*, 2011, accessed July 12, 2012, <http://hdr.undp.org/en/data/trends/>.

³¹² “Sao Tome and Principe : Socioeconomic Overview,” *Africa Adaptation Programme – UNDP*, July 17, 2012, <http://www.undp-aap.org/countries/sao-tome-and-principe>.

³¹³ “Sao Tome and Principe Facebook Statistics,” *Social Bakers*, July 17, 2012, <http://www.socialbakers.com/facebook-statistics/sao-tome-and-principe>.

show any activity coming from the STP, although there are some accounts captioning topic on STP, those accounts are usually operated by journalists and cultural promoters.³¹⁴

Overall, it is hard to penetrate the society of Sao Tome and Principe, which is locked by multiple factors like language (Portuguese; and there little material online in English or French), the isolated nature of the archipelago, and the small size of its population.

4. Information Technology Dependency

As confirmed by the low level of activity in social media and the lack of useful information on potential information systems operating in the country, information technology use in Sao Tomé and Principe is still in its infancy. Although the state is engaged in infrastructural programs for interconnection to undersea fiber-optic cable, corporate use of ICTs is very low. Overall, there is no indication of dependency on technology at all.

E. CRIMINAL ACTIVITIES

STP's legal system is based on a collection of Portuguese colonial laws in force before the country's independence in 1975. Generally speaking, the country lacks a modern legal system with the features of contemporary business law.³¹⁵

Regarding the cybersecurity picture, Sao Tomé and Principe does not show any serious concern regarding cybersecurity. It is worth mentioning though that the country's domain name is not yet administrated by local authorities, a Swedish company manages it. This situation has led to illicit use of the official domain name of STP for inappropriate web services across the world, like Sex Telephony (.ST), or Style. The existing laws of

³¹⁴ "Sao Tome and Principe Online Blog," *Global Voices*, accessed July 17, 2012, <http://globalvoicesonline.org/-/world/sub-saharan-africa/sao-tome-and-principe/>.

³¹⁵ "The Investor's Guide to Sao Tomé and Principe," *The Earth Institute* –New York : University of Columbia (2008), accessed July 17, 2012, <http://www.vcc.columbia.edu/pubs/documents/SaoTome-sept11eng.pdf>, 36.

telecommunications are silent on cybersecurity issues and legislation. However, the country is involved in regional collaboration to define legislation to counter transnational cyber issues.

The website ProjectHoneyPot.org, which surveys malicious activities online based on honey-pot servers, does not propose any statistical data on the country. This may be another indication of the absence of threat coming from that direction.

F. CONCLUSION

Although the country has a promising future due to its sociopolitical stability and the high level of literacy, the limited size of the population and territory does not play to the advantage of STP in its competitiveness on the world scene. The potential of oil exploitation and the imminent connection to undersea cable will certainly boost progress toward an information society.

With the undersea cable, the costs of international links for voice telephony and the Internet will drop dramatically. Sao Tomé and Príncipe has made significant progress in mobile telephony. The challenge now with the arrival of optical fiber is to sustain that trend and introduce a second operator, then extend its success to broadband Internet access. Improvement of government and regulatory systems are a more general matter, not confined to telecommunications, where obviously further progress is required.

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